SCIENCE

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FRIDAY, MARCH 1, 1901.

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MSS. intended for publication and books, etc., intended or review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

THE AMERICAN SOCIETY OF BACTERIOLOGISTS.

THE American Society of Bacteriologists held its second annual meeting at Baltimore, at the end of December under the presidency of Professor Wm. T. Sedgwick, whose address has already been published in SCIENCE. The following papers were presented:

Distribution of Bacillus ærogenes capsulatus: W. H. WELCH.

Dr. William H. Welch presented the results of investigations of Mr. L. K. Hirshberg in the Pathological Laboratory of the Johns Hopkins University. There can be no question but that the bacillus discovered by Welch in 1891 and fully described by Welch and Nuttall in the following year is identical with Fraenkel's *B. phlegmones emphysematosæ*, with Veillon and Zuber's *B. perfringens*, and with Schattenfroh and Grassberger's *Granulobacillus saccharobutyricus immobiles liquefaciens* described in 1900. It is possible that Klein had in his cultures *B. ærogenes capsulatus*, but his description of his *B. enteritidis sporogenes* can not be reconciled with the properties of the former bacillus, especially his statements as to motility and peptonization of milk. It has already been demonstrated by Welch, by Howard, and by Hitschmann and Lindenthal that *B. ærogenes capsulatus* is a widely distributed organism, its natural habitats being especially the intestinal canals of man, animals

and the soil. Mr. Hirshberg has, during the past summer, made a systematic study of the distribution of this bacillus in various situations. Various methods were employed for its isolation, one of the most useful being the inoculation into the circulation of rabbits, which were then killed according to the procedure described by Welch and Nuttall. In each instance the bacillus, if found, was isolated in pure culture, and identified by its characteristic properties. *B. ærogenes capsulatus* was found by Mr. Hirshberg regularly in the feces of man (being isolated from all parts of the intestinal canal), of swine, of dogs and of cats, and was found with varying frequency, as a rule, in 50 to 80 per cent. of the animals examined, in the feces of rabbits, guinea-pigs, mice, rats, chickens, pigeons and cows. It was likewise obtained from the excrement of flies hovering around the bodies of infected animals or human cadavers. It was isolated constantly from garden earth, rarely from street dust. It was detected four times out of eighteen examinations of dust swept from the floors of hospital wards, the dispensary or the laboratory. Once it was obtained in scrapings from the human skin. It was isolated twice from cesspools. The results of Schattenfroh and Grassberger concerning the presence of this bacillus in market milk were confirmed. In the light of these and previous investigations *B. ærogenes capsulatus* must be regarded as the most widely distributed of bacteria.

The Bacterial Condition of City Milk and the Need of Health Authorities to prevent the Sale of Milk containing Excessive Numbers of Bacteria: H. W. Park, New York.

The author raised the question whether it is possible for health boards to set a limit to the number of bacteria which milk may contain, and above which its sale could be prohibited. During the coldest weather the milk in New York City averages about 250,000 bacteria per cc., during cool weather about 2,000,000 and during hot weather about 5,000,000. The milk in other large cities is, from all accounts, in about the same condition. The above statement does not apply to the special milks which contain only from 5,000 to 20,000 bacteria at the different seasons of the year. In answer to the question whether these enormous numbers of bacteria found in milk during the hot weather are harmful, reference need only to be made to the universal clinical experience that a great number of children in cities sicken on the milk supplied in summer; that those who are put on milk that is sterile, or contains few bacteria, as a rule, mend rapidly, while those kept on the impure milk continue ill, or die. We probably have, as yet, insufficient knowledge to state just how many bacteria must accumulate to make them noticeably dangerous in milk, but it is a safe conclusion that no more bacteria should be allowed than it is practicable to avoid. Any intelligent farmer can use sufficient cleanliness and supply sufficient cold, with almost no increase in expense, to supply milk 24 to 36 hours old which will not contain in each cc. over 100,000 bacteria, and no milk poorer than this should be sold. The most deleterious changes which occur in milk during its transportation are now known to be due to the changes produced by bacterial growth and activity. These add to the milk acids and distinctly poisonous bacterial toxins to such an extent that much of the milk, by the time it is used in summer, has become decidedly injurious to invalids and infants. While it is the universal custom of the health authorities to guard their milk in many ways, they nevertheless entirely fail to prevent the sale of milk rendered unfit for use through excessive numbers of bacteria and their products. This seems all the more remarkable when we consider how comparatively easy the

test, and how rapidly the farmer and middle-man could greatly improve the bacterial purity of their milk if only their dense ignorance and lack of desire to improve could be removed.

Duration of Life of Typhoid Bacilli, derived from Twenty Different Sources, in Ice; Effect of Intense Cold on Bacteria: W. H. PARK, New York.

Cultures derived from twenty different cases of typhoid fever were grown 28 hours in nutrient agar. From each one a loopful was inoculated into 300 cc. of sterile distilled water and this was poured into thirty glass tubes. These were kept in a room averaging 23° F. (−5° C.). From time to time a tube was removed and the number of bacilli which should develop in nutrient agar tested. The following table gives the results:

Number of weeks frozen.	Per cent. of bacilli living.	Per cent. of cultures living.
0 (Original)	100	20
½ week	42	20
1 week	14	20
2 weeks	7.50	20
3 "	.4	20
5 "	.11	18
7 "	.09	18
9 "	.05	17
12 "	.005	11
15 "	.002	8
18 "	.0001	3
22 "	none	0

Watery suspensions of typhoid, colon diphtheria and hay bacilli and of the *Staphylococcus pyogenes aureus* were placed in small tubes and dropped into liquid air. From time to time the tubes were removed and the contents plated in nutrient agar. The percentage living was as follows:

Per cent. living after exposure of	Typhoid.	Colon.	*Staph.*	*B. subtilis.*
3 min.	18	19		
20 "	10	11	85	80
60 "	7.5	8	51	67
130 "	3	5.5	27	55

The virulence of the organisms was only slightly diminished by this intense cold for two hours.

The Use of Paraffin to exclude Oxygen in growing Anaërobic Bacteria: W. H. PARK.

Nutrient glucose bouillon in tubes or flasks covered with a layer of paraffin, melting at 42° C., has proved very useful in the devolopment of tetanus cultures and toxins and of other anaërobic bacteria. With bacteria not possessing spores the medium is quickly cooled and inoculated and then covered by a layer of very hot sterile paraffin. The accumulation of gas forces the paraffin up in the tube or flask, but does not allow the entrance of oxygen. When absolute exclusion of oxygen is desired, the tubes with their layer of paraffin are sterilized in an autoclave which renders them free from oxygen. Spore-bearing bacteria are inoculated through the liquid paraffin before the bouillon is fully cooled. Bacteria without spores are inoculated by breaking through the paraffin film or by heating the paraffin in a gas flame. A pipette can then be carried through the hot paraffin into the cool liquid below. The paraffin layer has also been found useful in preserving media from drying or from changes due to the absorption of gases of the air.

Bacteria in the Ames Sewage Disposal Plant: L. H. PAMMEL, Ames, Iowa.

The author describes a sewage plant designed for the disposal of the sewage of about six hundred people. The plant is of the ordinary type, consisting of two beds, each covering about 0.2 of an acre. The filtration in the beds was at the rate of about 100 gallons a day, per acre. The whole plant was installed for about $3,000. The efficiency of the filter bed was shown by bacteriological analysis. The effluent of the filter bed for 1899 showed an average of 5,127 bacteria per cubic centimeter, and at no time did it rise over 11,075 per cc.

The number of bacteria in the water in the tank varied largely with the temperature, rising in September to 9,000,000, and falling in colder weather to a little over a hundred thousand in March. The filter bed was, therefore, extremely efficient in removing bacteria. In the study of the species of bacteria found in the effluent, some of the common sewage types were found. The author found, also, in this effluent, *Bacillus prodigiosus*. This was interesting inasmuch as it made its appearance in the sewage after it had been introduced into the laboratory in Ames. It was not believed, however, to be a native of the locality, but an introduced species.

Variations of Bacillus rosaceous metalloides (Dowdeswell): Nelson G. Davis, Lewisburg, Pa.

During the summer of 1896 a series of experiments was begun on the variations of *Bacillus rosaceous metalloides*. In making a pure culture of the organism, it was noticed that one colony was much paler in color than the others. No pigment appeared until the colony was some days old. Replating from this colony, all the daughter colonies were colorless until the fourth day, when a pale pink pigment appeared. After a time the characteristic metallic luster became visible. A continuation of the replating and selection of colonies was kept up for nine months. By that time cultures of the *Bacillus rosaceous* varying in color from colorless to a deep red, deeper than the original variety had been obtained. The darkest variety of all appeared as a 'sport'; so did also the first pale colony. The other variations appeared as gradual modifications. An attempt was made to produce a variety that would not liquefy in gelatin. This was unsuccessful, although in two instances the colonies were obtained, much slower than usual in their action. Similar selection experiments demonstrated great varieties in the size of the organism. After about two hundred replatings, there appeared in one of the gelatin plates a colony in which the length of the elements was the same as the breadth. In other words, it appeared to be a coccus 0.5 μ in diameter, and was so described by students. This variety was cultivated in various media, at various temperatures, in light and darkness. It remained constant in size.

Some Varieties of Bacillus pyocyaneous found in the Throat: F. P. Gorham, Providence, R. I.

Bacillus pyocyaneous is a comparatively frequent form in the nose and throat. Two varieties can be distinguished, one producing both pyocyanin and a fluorescent pigment, the other producing only pyocyanin. These forms are often present in almost pure culture, and may persist in the same individual for several months. The cultures are virulent for guinea-pigs and rabbits.

Demonstration of Photogenic Bacteria: F. P. Gorham.

Cultures of several varieties of phosphorescent bacteria were exhibited at the evening session. They were growing on fish, fish-agar and fish-bouillon. Some of the cultures were remarkably luminous.

Bacillus Lactis Viscosus, a Cause of Ropiness in Milk and Cream: Archibald R. Ward, Ithaca, N. Y.

The writer has closely observed the occurrence of the milk fault, known as 'ropy milk,' in the creameries of three different milk dealers in widely separated localities in New York State. *Bacillus lactis viscosus*—Adametz, has been found to be the cause of trouble in each outbreak. The identification of the organism found in the ropy milk was confirmed by Dr. Adametz, who studied a culture sent for identification, and pronounced it identical with the one first de-

scribed by himself. Attention is called to the fact that in several text-books there occurs an erroneous statement to the effect that the organism brings about the viscid condition in milk very slowly, and that it is, therefore, of no practical importance to dairymen. The statement is founded upon a misconstruction placed upon a sentence written by Dr. Adametz. The organism is found in water, and multiplies at a temperature as low as 8° C. These characteristics, together with the method of keeping the milk, account for the persistence with which ropy milk appears on a milk route when the creamery is once infected. In all the cases coming under my observation, the milk dealer has cooled the milk in long, open-topped cans standing in ice water. In each case the ice water was found to contain the organisms. These might readily be introduced into the milk by the spattering of water incident to the removal of cans, addition of ice, etc. That the ice water was the immediate cause of trouble was indicated by an experiment in which potassium bichromate was added to the ice water in the proportion of one part to one thousand parts of water. The trouble did not recur in those cans of milk which were placed in the water after the addition of the disinfectant. In this case scrupulous care was observed in sterilizing vessels which had been infected.

Concerning the Presence of Streptococci in the Healthy Udder of a Cow: R. C. REED and A. R. WARD.

At intervals between November, 1897, and July, 1900, the presence of streptococci in the freshly drawn milk of a cow in the Cornell University herd was noted. While some cases of mammitis, associated with streptococci, were known to have occurred in the herd during this period, yet we had no record that this cow ever suffered an attack. The fact that she led the herd in butter production during the period in which the streptococci were observed in the milk indicates that the cow was not suffering from a chronic form of the disease. This fact is significant in view of the serious effect of mammitis on the secretion of milk. The slaughter of the animal in the summer of 1900 afforded an opportunity to study the bacterial flora of the udder by means of cultures made directly from all parts of the gland. In addition to some organisms commonly found in the udder, streptococci appeared in all the thirty-six cultures. In conjunction with the streptococcus under consideration one culture from a sporadic case of mammitis and one from an epizootic of the same disease were studied. In their cultural, morphological and pathogenic properties the streptococcus from this healthy udder was indistinguishable from those isolated from the cases of mammitis. None were pathogenic to guinea-pigs or rabbits, but all three induced mammitis when injected into a healthy udder. While these observations are incomplete, they can not but suggest the idea that the streptococci associated with mammitis may, like the specific organisms of diphtheria and pneumonia in the healthy throat, be harbored in the healthy udder without producing disease.

Immunization of Animals to Rattlesnake Venom, and some studies of Antivenine: JOSEPH MCFARLAND, Philadelphia, Pa.

In order to determine whether the experimental immunity to serpents' venom, upon which Calmette has done such interesting work, applied equally well to venoms of the cobra and rattlesnake. The endeavor was made about two years ago to immunize several horses to the venoms of American rattlesnakes. The problems encountered were more difficult than those with which Calmette had to contend, because of the intense local irritative action

of the venom. Cobra venom possesses this local irritative property in very slight degree, and Calmetti found that when the cobra venom was heated to 70°C., for an hour, it was completely set aside. It was found, however, that when rattlesnake venom was heated sufficiently to annul its irritative qualities its toxic properties were almost destroyed. The horses at first received heated venom, but later were injected with solutions of the dried venom in its normally active state. The injections were given subcutaneously and were followed by enormous edemata, necroses and sloughs, so that after determining that no immunity to the local action developed, this method was abandoned and the intravenous used. The interior of the vessels showed no sign of injury, probably because the well-diluted venom at once met with greater dilution in the circulating blood. No local or other irritative disturbances followed the intravenous injection, but the nervous impression was profound; the horses often fell, and remained unconscious for some minutes after injection, and, to prevent injury to themselves, required to be suspended. Two of three horses died before antivenine developed from the damage to their tissues caused by the irritation of subcutaneous injections. The third horse lived for a long time and developed a very marked immunity associated with the appearance of antivenine in the blood. The death of the horse finally resulted from the unfortunate accidental entrance of some venom into the sheath of the jugular vein during one of the injections. Not being immuned to its irritant effects, the venom produced a local edema which killed the animal by suffocation. The antivenine produced by this horse was of such strength that 2 cubic centimeters of the serum protected a rabbit —an adult rabbit—against a fatal dose of either rattlesnake (0.002 gram) or cobra (0.001 gram) venom.

How can Bacteria be Satisfactorily Preserved for Museum Specimens? H. W. Conn, Middletown, Conn.

A method of preparing museum specimens was described. A 2-per-cent. agar culture medium is placed in large test tubes and tilted so as to make agar slants. The tubes are left undisturbed for from six to eight weeks, in order to allow the surplus moisture to evaporate. They are then inoculated in long streaks and immediately sealed with plaster of Paris and paraffin. The cultures grow for a few days, then cease growing, and remain unaltered indefinitely. No disinfectant is needed. The cultures remain alive for many months, and possibly for years. The method is satisfactory except for one fact—the atmosphere in the tube becomes filled with moisture and this condenses on the inside of the tube with changes of temperature. No method has yet succeeded in avoiding this condensation of water, which in most cases renders the tube cloudy, and injures its value as a display specimen.

The Effect of Salt Solution and other Fluids on Bacteria compared with Serum Reaction: Adolph Gehrmann.

The author described, first, a series of experiments to determine the effect upon bacteria (typhoid and colon bacilli) of transferring them from one solution to another in which the percentage of salt is less. These experiments showed that, if the salt was not stronger than one per cent., the solution did not materially injure the bacteria, and did not produce the plasmolysis and plasmotypsis described by Fisher. Solutions of one per cent. have an inhibiting action and cause typhoid cultures to develop long chains and to lose their motility. A second series of experiments tested the effect of salt in the diluting fluids which were used in making the serum tests. Distilled water, normal salt

solution, and a bouillon culture fluid, made both with .5-per-cent. salt and without salt, were compared side by side, and were found to be fully equivalent. Blood diluted with any of the above readily produced the agglutination test, about the same time elapsing in all cases before the agglutination occurred. A further series of experiments tested the influence of the viscosity of fluids upon motile bacteria, as aiding in explaining agglutination. These experiments showed that the typhoid bacillus becomes readily agglutinated in fluids having considerable viscosity. For testing this phenomenon, gelatin and egg albumen were used both of which caused the bacilli to adhere in clumps, which, however, were dissipated if the solutions were diluted. While these observations were regarded as having significance in interpreting the serum test, the author was of the opinion that, when properly conducted, the agglutination obtained in the serum test can readily be distinguished from that which is the result of such physical conditions.

Growth of Bacteria in the Presence of Chloroform and Thymol: ERWIN F. SMITH, Washington, D. C.

As an illustration of the frequent dependence of bacteriologists and physiological chemists upon chloroform as an antiseptic, the speaker cited various passages from the recent valuable English work of Green on 'The Soluble Ferments and Fermentation.' In this book there are many statements and implications that animal and vegetable infusions can be preserved from bacteria growths during their examination by the addition of chloroform. Twelve micro-organisms are known which grow readily in test-tube cultures of milk, beef bouillon, etc., to which an equal volume of chloroform has been added. This probably by no means exhausts the list. Test-tube cultures of eight of these organisms growing readily in presence of chloroform were exhibited. Two organisms are also known which grow readily in beef bouillon to which thymol has been added. It would appear, therefore, that there is no general rule, but that each bacterial organism must be tested by itself as to the effect upon it of chloroform, thymol, etc. If chloroform is used to preserve fluids or macerations of animal and vegetable substances from the growth of micro-organisms, it would be well to seal the flasks and keep them constantly agitated. Moreover, if one would be certain of their continued sterility, the freedom from bacteria growth of the substances under examination must be determined from time to time by microscopic examination and by cultures made from the fluids or macerations, otherwise, especially where bacterial organisms are able to produce the same substances as those sought for in plant or animal tissue, *e. g.*, cytase, diastase, etc., there can be no certainty as to the exact origin of the substance in question.

Infection by means of Modeling Clay: M. O. LEIGHTON, Montclair, N. J.

The author's attention is drawn to the possibility of the distribution of infectious disease among school children by the common use of model-clay. In the ordinary schools such clay, after having been used by one student, is returned to the stock box and subsequently used again. Study of clay thus obtained from schools showed bacteria to be tolerably abundant in the clay. The species of bacteria identified were those which ordinarily occur in pus formations, thus showing that clay may be capable of distributing these organisms. An attempt to sterilize clay showed that the only efficient means of accomplishing this purpose is by the use of superheated steam under the pressure of 15–20 pounds for 45 minutes. Next, an attempt was made to

determine how long certain pathogenic bacteria could remain alive in the clay. Sterilized clay was inoculated under proper precautions, with the bacilli of typhoid, diphtheria and tuberculosis. The clay was then kept moist and warm, and studied periodically for the presence of these organisms. The results were, briefly, as follows: *B. Typhi abdominalis* grew vigorously after having been enclosed in the clay for 32 days. After that no colonies were found. *B. diphtheria* grew after having been enclosed in the clay for 18 days. *B. tuberculosis* was alive after 18 days. How much longer the latter two bacilli would remain alive in the clay the author did not determine. The experiments, however, sufficiently demonstrate that the indiscriminate use of modeling clay in the schools is unwise, and liable to distribute communicable diseases, if such are present among the pupils.

A Preliminary Report upon a Hitherto Undescribed Pathogenic Anaërobic Bacillus: Norman Harris, Baltimore, Md.

This organism was isolated, post-mortem, from one of several abscesses in the liver of a man who had entered the service of Professor Halsted in the Johns Hopkins Hospital of Baltimore. He complained of great pain in the hepatic region of the abdomen, accompanied by nausea, vomiting and jaundice. Blood examination showed a marked leucocytosis. Exploratory laparotomy was performed and the condition was found to be one of multiple abscess of the liver, and beyond radical treatment. The patient died the fourth day after operation. The autopsy disclosed the presence of numerous abscesses throughout the liver, as well as in the right lung and spleen. Petri dish cultures were made in plain and in hydrocele fluid agar and grown both aërobically and in an atmosphere of hydrogen for a period of seventy-two hours. All dishes showed no growth, except the undiluted hydrocele fluid culture which had been in the hydrogen atmosphere. This developed four colonies surrounded by a halo of growth, and these appeared to arise from small particles of liver detritus. Subcultures were successfully grown only when the media were made up with hydrocelic fluid or human blood, and when oxygen was excluded. Characteristics: the organism is a bacillus which in general is not minute, although its size varies somewhat on the various media. It may occnr as cocci diplococci, very short rods, longer rods, filaments, or more rarely as chains of cocci or very short rods. Occasionally some rods are seen to have swollen ends, or may show distinct polar granules, or may be slightly curved. It is non-motile; it is decolorized by Gram's method of staining; it does not liquefy gelatin; it does not appear to have spores; its thermal death point is an exposure of ten minutes at 50° C. In all media it gives off a very strong fecal odor, and forms gas from the ordinary and sugar-free beef broth, when made up with either hydrocele fluid or blood. It likewise actively ferments glucose, forming CO_2, H, and H_2S, the gas igniting readily. Experimentally, lesions similar to those found in the human subject were produced in rabbits and guinea-pigs, and mice succumbed to subcutaneous inoculation with a local necrotic lesion only. The name proposed for the organism is *Bacillus mortiferus* or *Bacterium mortifer*. The organism differs essentially from any of anaërobic bacilli hitherto described.

Concerning the Theories of Silage Formation: H. L. Russell and S. M. Babcock, Madison, Wis.

The authors instituted along series of experiments to determine whether the changes that take place in the silo are due to microorganisms, as has been believed, or to other

kind of action. Their conclusions are: (1) Silage can be made under conditions that exclude bacterial activity. (2) The initial heating of the silage is due, mainly, to the respiratory processes of the cut plant tissues. (3) The peculiar characteristic of good silage is due, not to bacteria, but to changes inaugurated under the more or less direct control of the activity of the protoplasm of the plant tissues. The acids of silage seem to be for the most part a product of the intra-molecular respiration, and in quantity are roughly proportional to the length of time that ensues before the cells stop respiring. This fact explains the reason that silage from immature corn has a higher acidity, and is more likely to undergo putrefactive changes due to bacteria growing in the succulent tissues than silage made from mature corn. (4) The aroma of good silage can be produced under conditions in which all vital processes are suspended. This seems to point strongly to the idea that enzymes are operative in the production of this aroma. It has previously been shown that such ferment bodies are liberated from dying vegetable cells and that they continue to act after the cells lose their vitality.

Demonstration of some New Laboratory Devices: F. P. GORMAN, Providence, R. I.

The following laboratory devices were demonstrated: (1) The application of the incandescent electric lamp to heating incubators, water and paraffin baths. (2) Culture tubes with etched surface for writing data. (3) Large slides for the examination of series of cultures. (4) Cotton 'silver' for plugging tubes, etc.

A Low Temperature Incubator: E. H. WILSON, Brooklyn, N. Y. (Read by title.)

Preservation of Sputum for Microscopic Examination; A New Fermentation Tube: A. ROBIN, Newark, Del.

The author has experimented with some of the active germicides with a view to preserving tuberculosis sputum. Carbolic acid, 5-per-cent. solution; trikresol, 2-per-cent.; formaldehyde, 5-per-cent., and hydrochloric acid, 10-per-cent., were added to sputum containing large numbers of tubercle bacilli. The coagulation resulting from the addition of carbolic acid or trikresol to sputum containing pus was largely overcome by vigorous shaking, the coagulation being thus finely broken up. The sputum was examined at the end of 24 to 48 hours. Weekly and then monthly examinations were made for a period of four months. Except when hydrochloric acid was used, the bacilli were found well preserved and, if anything, stained much more deeply. HCl, on the other hand, seemed to have either so disorganized the bacilli or so changed their staining properties that they could not be

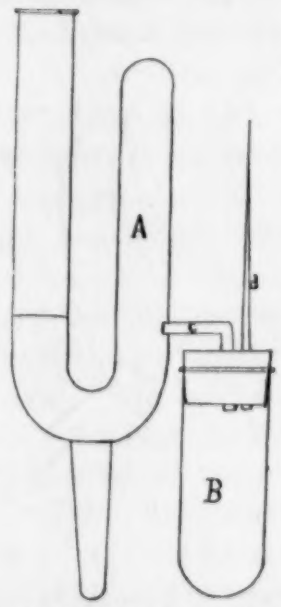

FIG. 1. A New Fermentation Tube.

found at the end of 24 hours. As a result of these experiments the author recommends the addition of an equal volume of a 5-per-cent. solution of carbolic acid to the sputum, which should be vigorously shaken up in the bottle so as to break up the lumpy coagulation. The apparatus is illustrated by the accompanying drawing. The side-tube *c* is packed with non-absorbent cotton; the arm *A* of the *U*-tube is filled with mer-

cury, the tube *B* is filled with the culture, when the rubber stopper holding the side-tube *d* and straight tube *d* is tightly inserted. When this is done the end of *d*, which serves for the escape of air displaced by the stopper, is sealed in the flame. The gas generated in *B* escapes into the closed arm *A*, displacing the mercury. To determine the CO_2 ratio, the tube *B* is filled to the rubber stopper. Two fermentation tubes are used. In one, the arm *A* is filled with mercury, and the other half of the arm is filled with a saturated solution of sodium or potassium hydrate, this being readily accomplished by inclining the *U* tube towards the operator. The CO_2, passing through the caustic solution, is absorbed, and the unabsorbed gas (H) is left. The ratio between the two is then determined. This apparatus is manufactured by Eimer and Amend, New York.

A New Method of applying the Rabies Test: Chas. F. Dawson, Detroit, Mich.

The author, in his work upon rabies, was dissatisfied with the current method of inoculating animals in the cerebrum, which involved trephining the animals, with occasional death from hemorrhage, possibility of self-inoculation and other difficulties. He has, therefore, devised a method of inoculation in which these difficulties are reduced or eliminated. The method is as follows: A bit of the brain of the suspected animal is ground in a mortar containing sterilized 6-per-cent. sodium solution, and is then filtered through sterilized cotton. Two minims of this solution are then injected on the base of the anterior cerebrum by way of the optic foramen. To accomplish this, full grown rabbits are used which are thoroughly anæsthetized with ether. A hypodermic syringe is used with a needle seven-eighths of an inch long. The inoculation is made by lifting the nictitating membrane out of the way by means of the syringe needle, and then forcing the needle upwards and backwards through the orbital tissues until it enters the optical foramen. The contents of the syringe barrel are then injected and the needle carefully withdrawn. By this means the solution is injected underneath the cerebrum and the chances of injury to the animal are much lessened. In a series of comparative tests made with this and the ordinary method, the author reaches the conclusion that the new method is fully as satisfactory as the old, and much easier to apply.

The Use of Carbolic Acid in isolating the Bacillus Coli Communis from River Water: William B. Copeland, Pittsburg, Pa.

The author described a method which he had devised for the purpose of separating the coli bacillus in river water, by the use of solid media. For this purpose he used Wurtz's agar, inasmuch as it could be incubated at 37° and the acid colonies were readily distinguishable by the reddening of the litmus. Inasmuch, however, as many other bacteria are present in river water, especially after a rain, which can develop at 37°, it is quite desirable to devise some means by which they may be reduced without affecting the colon bacillus. The author accomplishes this by adding to the agar two-tenths cc. of a 2-per-cent. solution of carbolic acid. Experiments showed that such addition of carbolic acid reduced the total number of bacteria about 45 per cent., while it had no effect, apparently, upon the colon bacillus. This makes it possible to determine the number of colon bacillus in water much more readily than if all bacteria are allowed to grow. By the use of this method, a study of the relation of the muddiness of river water and the number of colon bacilli was made. The result showed that, leaving out certain irregularities due to abnormal conditions, the number of colon bacilli increased with the turbidity of the water, a

relationship pointing to an increase in sewage pollution at times when the water of the river becomes turbid. The author recommends the use of carbolic acid as described in the employment of solid culture media for the determination of the number of colon bacilli present in surface waters without dilution.

A Few Experimental Data on Hypodermic Injections: S. J. MELTZER, New York City.

From two series of experiments, Meltzer arrived at the conclusions: (1) That the effect of subcutaneous injection depends to a very large degree upon the concentration of the injected fluid, and very little, if any, upon its bulk; (2) that the effect is distinctly increased by a distribution of the injected quantity over several areas. The author employed crystalloid solutions, and restricts his conclusions to this kind of liquids.

The Utility of a Supply of Live Steam in the Laboratory: H. A. HARDING, Geneva, N. Y.

The expense connected with cooking and sterilizing in the bacteriological laboratory is usually great, because of the high cost and low efficiency of gas. As a saving of time and money, the advantage of using steam, generated directly by coal, is obvious. In fitting up the bacteriological laboratory at the New York Agricultural Experiment Station, the following devices have been tried and found satisfactory: In the case of the Arnold sterilizer, a steam pipe was introduced through the wall of the passage in which the steam normally rises into the sterilizing chamber, and an elbow screwed to the end of this pipe and turned downward. With this connection, the Arnold can be brought to a temperature of 99° C. within five minutes, without any unpleasant noise or undue waste of steam. An autoclave was constructed, differing from the ordinary type in that steam was introduced from a high pressure boiler. By means of a reducing valve the steam pressure and, consequently, the temperature within the autoclave, can be held within very narrow limits. A ten-minute exposure at 120° C. suffices to render tubes of gelatin and other media sterile. Steam cups were installed, having the shape of an ordinary water-bath, except that their depth was considerably increased. A steam inlet was placed at the bottom, and a waste pipe provided for carrying off the condensation. In these cups water is heated and agar is melted much more quickly than it could be done over an ordinary Bunsen burner, and in cooking media there is no possibility of boiling over or burning. The above pieces of apparatus, together with the hot air sterilizer, are placed upon an eight-foot bench, and nearly all the heat radiated is carried off by a galvanized iron hood. These devices have been in use for nearly two years and are giving good satisfaction.

H. W. CONN,
Secretary.

WORK AND EXPENDITURES OF THE AGRICULTURAL EXPERIMENT STATIONS FOR THE YEAR ENDED JUNE 30, 1900.

THE Secretary of Agriculture has recently transmitted to Congress the annual report on the work and expenditures of the Agricultural Experiment Stations, made by A. C. True, Director of the Office of Experiment Stations. The following paragraphs are taken from the introduction to this report:

THE WORK OF THE STATIONS AS RELATED TO PRACTICAL AGRICULTURE.

In making our examination of the work of the experiment stations during the past year we have particularly inquired whether their operations are conducted with special reference to the agricultural needs of their

respective States and Territories. The results of this inquiry are embodied in the accounts of the individual stations given in this report. From these it will be seen that by far the largest part of the work of our stations has direct relation to the important agricultural interests of the communities in which they are located. The stations are, in fact, very responsive to the immediate demands of their farmer constituencies. Their greatest danger is not that they will undertake too much work of remote practical bearing, but that in the effort to meet the calls made upon them for immediate assistance they will attempt individually to cover more fields of investigation than the funds at their disposal will permit them to treat thoroughly. This temptation the stations generally are, however, resisting more successfully as their work is becoming better organized and their investigations are more carefully planned and supervised. The nature of their operations is also becoming better understood by the farmers, and the desirability of more thorough and far-reaching investigations is much better appreciated than formerly. A broader and deeper foundation of scientific inquiry is being laid each year, and there is a constant accumulation of data regarding the general agricultural conditions of the different regions of the United States. The climate, soil, water supply, native and cultivated plants, injurious insects, fungi and bacteria are being studied in more detail and with greater thoroughness than ever before. The principles of nutrition of animals and the causes of their diseases are being subjected to more elaborate and fundamental scrutiny. Methods of investigation and the improvement of apparatus for research are being given increased attention. Much of this work is done without public observation and in the intervals of other operations. Without doubt it should receive more definite recognition and encouragement. But it is cause for congratulation that so much patient labor of this character is being performed by station officers, who, as a rule, are seeking to advance the boundaries of knowledge for useful ends and are not deterred by a multiplicity of duties from giving attention to the more fundamental concerns of agricultural science. And this work is having its effect on the more practical operations of our stations. These are assuming a more substantial and systematic character and are being conducted with more definite relation to actual conditions. They have, therefore, a greater assurance of successful practical outcome. Questions relating to the introduction of plants or to the improvement of the live-stock industry in any region, for example, are now being investigated with a strict relation to the real requirements of the agriculture of that region which would have been impossible a few years ago. The present activity in plant breeding, as distinguished from the indiscriminate testing of varieties, is a good example of the raising of the level of experiment-station work as applied to directly practical ends. The plant breeder now sets definitely before him the kind of variety needed by the farmer in a given region or for a given purpose and applies all his scientific knowledge and practical skill to the production of such a variety. The notable success of some of the efforts in this direction already made are but a foretaste of much wider practical results as knowledge and experience in this line of endeavor increase. To do such work effectively there must be an almost ideal combination of science and practise. And the more we can learn definitely regarding the underlying principles, the more surely shall we be able to make successful practical applications. In such investigations science becomes more practical and art more scientific.

PROBLEMS OF STATION ORGANIZATION.

Much attention has been given during the past year to questions relating to the more perfect organization of the stations. As the stations develop, the importance of a clearer definition of the functions of different officers in administration and investigation becomes more apparent. Conditions which existed when institutions for higher education and research were established in this country have materially changed, and the old forms of organization are now, in many cases, a serious hindrance to their best development. For example, the theory on which the laws relating to the governing boards of many of the State colleges and experiment stations are based is that the board is to have the direct control and management of the institution. For this purpose it is to meet frequently, keep the details of the business of the institution well in hand, consult freely with officers of various grades and pass rules and regulations governing every operation. This may, perhaps, have been well enough when the institutions were in a formative period and trained executive officers were scarce, but to-day this theory is out of date and its application to the intricate and specialized business of our colleges and stations is highly injurious to their best interests. It works just as badly when applied to a college or experiment station as it would in the case of a railroad or a bank. The fact is that boards of control are most useful when their functions are confined to a broad, general supervision of the policy, finances and work of the institution and the choice of its chief officers. For this purpose annual or semi-annual meetings would ordinarily be sufficient, since the number of matters requiring the attention of the board should be reduced to a minimum. The best reason for the continuance of such boards is that when composed of broad-minded and successful citizens they represent the best sentiment of the community regarding these institutions, and are able to give the public an adequate guaranty for the wise and liberal management of the great interests involved in the State colleges and universities. Otherwise it would probably be best to do away with the boards and make the heads of the colleges directly responsible to some State officer of high rank. One especially annoying and unjustifiable feature of the present system is the maintenance at many of the colleges of an officer, commonly designated secretary of the board, who acts as a representative of the board in the intervals between their meetings and exercises important functions relating to the business of the institution independently of its president. There is thus divided responsibility in the daily administration, and in case of friction between the president and faculty or students often a convenient center for discontent and disloyalty is ready at hand. All the legitimate functions of a secretary of the board might easily be performed by a registrar or other officer attached to the president's office, and thus an important 'rock of offense' might be removed from the administrative systems of these institutions.

The successful college president is no longer preeminently a great scholar, but rather a broad-minded and well-trained man of affairs, understanding the requirements of modern educational and scientific institutions and able to administer the affairs and manage the personnel of such institutions. He will look to his governing board for advice and counsel on the larger matters of general policy, but he ought not to have their intervention in the details of the business. To his hands should be fully committed the administration of the whole institution, and his work should be judged with reference to its successful issue. There should be no doubt in the mind of any offi-

cer connected with the institution that he is responsible to the president for his official conduct, and that an appeal to the board can be made only in extreme cases.

The institution will naturally be divided into a limited number of departments, at the head of each of which will be placed an officer competent to plan and manage the business of the department intrusted to his charge. The amount and character of the administrative duties which these officers will be called upon to discharge will vary with the nature of the department. The agricultural experiment station is by law to be organized as a department of the college with which it is connected. It differs from the ordinary college department in being charged with the work of investigation rather than instruction and in having definite relations with a great industry for whose promotion it is especially established. Through its correspondence, publications, inspection service and association with the farming community it has an increasing amount of business not immediately relating to its investigations, but requiring special knowledge and skill for its successful discharge. To do most effective work the operations of the station must proceed in accordance with a well-matured plan which involves the cooperation of different members of the staff. So extensive and important has the business of the stations become that their proper management requires the time and energy of an executive officer, or director. In some cases it may still be possible for the director to conduct investigations in some special line or do a limited amount of teaching, but as a rule he can do little beyond attending to administrative duties. In a number of institutions prudential reasons of various kinds have led to the combination of the offices of president and director. Whatever justification there may have been for this in the past there is little excuse for it in the present. The duties of a college president are too multifold and onerous to permit his giving much attention to the special needs of an experiment station. His directorship almost necessarily becomes a nominal affair and the general business of the station is actually performed by some one member of the staff or distributed in a desultory way among a number of subordinate officers. This arrangement has not worked well and should be universally abandoned.

As regards the business of the station, the director should be clothed with a large measure of authority and consequent responsibility, should plan and supervise its work and expenditures, and control its staff to such an extent as will bring them together to work as a unit for the promotion of the station's success. The members of the staff should be directly responsible to the director on all matters relating to the station, whatever their position may be in other departments of the college, and should expect to transact station business through the director rather than through the college president or the governing board. A proper independence in the conduct of investigations, or parts of investigation, in their respective specialties, and just credit for their share in the station's operations as set forth in publications or otherwise may, it is believed, be amply secured for the expert officers of the stations at the same time that good discipline is maintained and ample provision made for united effort.

No class of men need to readjust their professional code to the modern requirements of the organization of great scientific and educational enterprises more than college professors and scientific specialists. A way must be found by which teaching and research can be conducted on a system which combines liberty with law. The old régime of the entirely independent teacher and investigator has passed away. The specialization which is simply a form of the

division of labor well known in industrial pursuits carries with it a necessity for combination of workers in educational and scientific institutions, as well as in manufacturing establishments. In a way hitherto unknown, scientific men will be called in the future to work together for common ends. No matter is of more vital importance in the organization of our colleges and experiment stations than the securing of harmonious and concerted action on the part of faculties and staffs for the common good of the institution to which they are attached. One of the greatest difficulties now attending the successful management of these institutions is the fact that while specialization has narrowed the field and outlook of the individual officer, there has not been a corresponding recognition of the necessity of readjusting the form of organization and the spirit of the worker to meet these new conditions. At no time has there been greater need of the cultivation of an earnest and enthusiastic *esprit du corps* among the rank and file of educational and scientific workers. There are many individual examples of men impressed with this lofty sentiment, but the whole body is not yet animated with it. Obviously it should especially be a virtue characteristic of men connected with public institutions. The officers of our agricultural colleges and experiment stations are public functionaries employed to advance very important public interests. With them the good of the community, as involved in the success of the enterprise with which they are connected, should be the ruling motive of action. The fame and emoluments of the individual worker should be subordinated to the requirements of concerted action for a common end. And yet in the long run it is believed the individual worker as well as the institution will profit by a loyal and self-sacrificing discharge of common duties, for union of effort will bring greater success; and whenever a college or a station is strong and flourishing, credit is reflected on every worker who has contributed to this issue.

The general considerations affecting the efficient organization of our experiment stations have thus been dwelt upon because a survey of these institutions during the past year has brought additional evidence that the problems of organization are being more generally considered than ever before. The tide is running strongly toward a more compact organization and a greater unification of the work. On the whole, those stations which have a strong organization and administration are meeting with the largest measure of success.

THE ORIGINAL WORK OF THE STATIONS.

There is also unusual interest in the discussion of problems relating to the functions of the stations and the specific duties of station officers. There is quite general agreement that each station should conduct a considerable amount of original investigation; but in what way this should be provided for and what should be its character are variously regarded. There is still great variety in the assignment of teaching and investigation to officers in different stations, and the relative amount of work of research which is left to assistants differs very greatly in different places. Considerations relating to the financial conditions of college and station still affect the assignment of work in a number of institutions. Our observation of the situation leads us to the belief that there is actually going on a widespread differentiation of the investigator from the teacher, and that this is not prevented, though it may be hindered, by the varying arrangements made at the colleges and stations. A certain number of men are more and more devoting themselves to the work of investigation, and succeeding in it. Others are just as certainly losing their interest and activity in

such work. Because a man is required to teach many hours he does not thereby become a successful teacher. The research which he is compelled to carry on during vacations and at night may nevertheless be his real mission, and it will be well if his superiors discover this. The leaving of details of research work to assistants often means that the principal has largely lost his interest in it or considers other duties more important. We are getting an increasing body of competent investigators by this process, though in too many cases their training is proceeding under untoward conditions. It will be well if boards and presidents will consider more fully the actual state of things and make as far as possible such a readjustment that the investigator will be left very largely to investigate and the teacher to teach. It continues to be a weakness of a considerable number of our stations that they are organized on too broad a scale for their resources. Too great a portion of their funds is going into salaries, leaving too little to pay the miscellaneous expenses of important investigations. Here and there only have the authorities had the wisdom and courage to confine the operations of the station within comparatively narrow lines, leaving important departments of work entirely without recognition. It is encouraging, however, to observe that where this has been done success has brought additional funds with which the scope of the station's work could be safely extended.

On the whole, the amount of what may fairly be called original investigation is, in our opinion, steadily increasing. To determine this it is not sufficient to consider simply the bulletins of the stations. These have in various ways been made more popular in form and matter. A larger amount of the more original work is being recorded in the annual reports and the records of more investigations are being withheld from publication until results of value are obtained. While there is still need of urging the advancement of the general standard of investigations, there is every reason to believe that our stations are moving onward and upward as agencies for the original investigation of agricultural problems.

THE INSPECTION SERVICE OF THE STATIONS.

The amount and variety of inspection service required of our experiment stations continue to grow from year to year. Beginning with commercial fertilizers, it now includes feeding stuffs, dairy products and other foods for man, creamery glassware, insecticides, nursery stock for injurious insects, and plant and animal diseases. For a considerable period this matter affected only the stations in the East, where commercial fertilizers were largely used, but it is now a live question in all sections of the country, since there is no region which does not have some evil against which the agricultural public is demanding protection by inspection under State or national auspices. Questions relating to the attitude of the stations toward this work are therefore engaging the attention of station officers throughout the country. Wherever this work has assumed considerable magnitude it is evident that it requires very careful organization in order that it may be conducted so as not to interfere with the work of investigation. Where the same officers are charged with both kinds of work there is constant danger that the severe routine duties of the inspection service will diminish the ability of these officers to conduct thorough original investigation. It is essential that there should be a distinct differentiation of this service from the other work of the stations as regards both funds and time of performance. Unless this is done and close supervision is exercised, the inspection work is inevitably a drain upon the resources of the station

and a hindrance to its more important operations. While our stations have from the beginning been engaged in inspection work, and this has met with increasing popular favor because of its efficient performance, it is still doubtful whether it is the best ultimate arrangement. Almost all our experiment stations are organic parts of educational institutions. As such they are essentially university departments devoted to research and to the dissemination of new knowledge. To a certain extent they may naturally and properly engage in the various forms of university extension work through their more popular publications and connection with farmers' institutes, etc. They are organized to conduct investigations on a great variety of subjects, and the scope of their work of investigation can be almost indefinitely extended as their funds increase. They do not need, therefore, to go outside of that work which would be universally considered within their rightful domain as departments of colleges and universities in order to secure a wide field of operation. On the other hand, as the range of inspection service enlarges and its duties become more onerous and complicated it becomes very questionable whether this service should be connected with our educational institutions. It is essentially a part of the police functions of the State and National Governments. It involves many questions on which sooner or later the courts will have to pass. It may even excite public attention to such an extent as to be reckoned worthy of consideration by the people in their choice of administrative and legislative officers. In many ways this kind of business is much more appropriate to bureaus of the State government than to educational institutions.

Thus far the arrangement by which much of it has been connected with the experiment stations has been largely a matter of convenience, and in many States the amount of work to be performed has been so inconsiderable that it has not seemed worth while to create special agencies for its performance. We have now reached a stage in the development of this work when it is believed that this matter should receive careful attention from the managers of our agricultural colleges and experiment stations, in order that a sound policy may be established which will provide for the best future development of these institutions. In our judgment, this would involve efforts to relieve the colleges and stations of the inspection service rather than to increase its scope at these institutions and make it a permanent portion of their work.

STATE AID TO THE EXPERIMENT STATIONS.

A number of the States continue to liberally supplement the national funds, and thus to extend and strengthen the investigation of the stations within their borders. This is done by specific appropriations for substations or special investigations, or by general appropriations for the current expenses of the colleges with which the stations are connected. Often the printing of station publications is provided for by the State. During the past year notable additions have been made to the buildings and equipment of the agricultural colleges, and the experiment stations have received much benefit from these increased facilities. At the University of Illinois a building costing $150,000 has been erected for the use of the agricultural college and experiment station. This will be thoroughly equipped with apparatus and other facilities for instruction, and when completed will form the largest single plant for agricultural instruction and research in this country. At the University of Nebraska a building costing $35,000 has been erected for the special use of the experiment station. At the Washington Agricultural College a science hall costing $60,000 has been erected, which provides

greatly improved facilities for the work of the college and station. At the Texas Agricultural College there is a new agricultural and horticultural building costing over $30,000, and at the Kansas Agricultural College an agricultural building of the same value. At the Oklahoma Agricultural College there are new chemistry and library and science buildings, and at the Virginia Agricultural College and the University of Tennessee new and commodious barns have been erected, each costing about $5,000. At the latter institution a dairy building has also been constructed. At the Agricultural College of the University of Minnesota a horticultural-botanical building costing $35,000 has been erected.

It is believed that the successful work of the experiment stations has been a large factor in arousing the attention of the public to the benefits of instruction as well as research in agriculture, and to the importance of equipping the agricultural colleges more amply and giving them increased funds for the extension of their work in both directions. It is well that this fact should be brought to the attention of legislators when appropriations for these institutions are being made. Funds are needed for the extension of investigations as well as for better equipment, and oftentimes a comparatively small sum added to the current revenue of the station will enable it materially to strengthen its work. This is so because the broad organization of our stations requires that a relatively large portion of the national funds must be expended for salaries and wages. This leaves so little for the general expenses of investigations that they can not as a rule be made very extensive. If it is desirable that particular investigations should be conducted on a somewhat extensive scale or in different localities, the State can often secure this desirable result by providing funds for these specific purposes. As regards the investigations which need to be carried on in different localities, it is, in our judgment, a much wiser policy to give the stations funds for such special investigations than to establish permanent substations, which have universally proved to be relatively expensive and unsatisfactory.

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*THE DEVELOPMENT OF THE EXACT NATURAL SCIENCES IN THE NINETEENTH CENTURY.**

The lecture delivered by Van't Hoff, under the above title, although scarcely an hour in length, contains so much important material that a brief account of its contents cannot fail to be of interest to the readers of Science. The lecture deals only with the sciences of inanimate nature, and, therefore, does not touch any branch of the biological sciences.

Although the question of utility has had much to do with the development of many branches of science, yet the highest aim has not been reached in this way. The sciences have, then, been divided into *theoretical* and *applied*. And we must make the further division into the *general* and the *concrete* or *special* sciences.

The general sciences are dealt with first. These are divided into two classes. First, the *three fundamental mathematical sciences*, which center around the three fundamental conceptions of quantity, space and time. The science of quantity is analysis, including arithmetic, algebra and the higher analysis. The science of dimensions is geometry; while in mechanics, the science of force and movement, time enters as a factor. Second, the two *experimental natural sciences*—physics and chemistry.

Almost an unlimited amount has been accomplished in the nineteenth century in the field of the mathematical sciences. It is only necessary to mention such names

* Lecture delivered by Van't Hoff at the seventy-second meeting of the Society of German Men of Science and Physicians, in Aix-la-Chapelle.

as Abel, Cauchy, Gauss, Jacobi, Riemann, Weierstrass. The general laws of these sciences were established at the beginning of the century, and remain essentially unaltered. The great discovery for mechanics in the nineteenth century is the law of the conservation of work. Since this law lies at the very foundation of mechanics, it is of fundamental importance for the whole science. The discovery and development of this law belongs to the field of physics, yet it was not developed by physicists alone. Mayer was a physician, Joule a brewer, Colding an engineer, and Helmholtz was at that time a physiologist.

The influence of this law on mechanics was pointed out by Lagrange in two equations—the one for motion, the other for rest or equilibrium. In the light of the law that the amount of work cannot change, these two equations became relatively very simple. This law is as follows: *The total amount of work is unalterable.* It should be observed that work can have two forms, the form of movement (or kinetic energy), and the form where a weight moves a clock—where the capability of doing work is connected with the weight, therefore, with a force, (potential energy). The law should be expressed thus: *The sum of the two kinds of work is unalterable.*

We can then say, in general, of our three fundamental sciences, that at the close of the nineteenth century they rest on a foundation that is practically perfect.

If we now turn to the experimental sciences, physics and chemistry, we find that there is no sharp division between them. Recently a celebrated chemist said that Lavoisier and Bunsen were not chemists, but physicists, and to show what inherent connection exists between the two, Bunsen himself said '*a chemist who is not a physician is nothing.*'

The physicist has to do chiefly with the transformations of *force;* the chemist with the transformations of *matter.*

Turning now to physics, therefore, to the problem of the transformations of natural forces or corresponding work forms, the developments in the nineteenth century are closely connected with the fundamental conceptions that natural processes are to be referred to purely mechanical movements and forces. Since light, sound, heat, electricity and magnetism are only different forms of movement, the possibility exists of transforming these into one another. This is the first great advance in physics. It was Faraday especially who believed in the correlation of energy. This reciprocal transformation of work forms, of course, takes place in daily life in the steam engine, dynamo, etc., and from this energy heat and light can be reproduced.

The second great advance is, of course, the law of the conservation of energy, or of work, in terms of which the total amount of work remains unchanged.

A third important step was taken. If one form of work can be transformed into another and this transformation takes place quantitatively, then the question still remaining is, Which way will the transformations take place? This was answered by Carnot and Clausius in what has become the second law of thermodynamics. This is often formulated thus: Heat always flows from a warmer to a colder body. Helmholtz formulates it in terms of 'free work.'

We now consider the *last fundamental step* which has been taken—how *quickly* do transformations take place in nature? This brings us to the views in reference to the inner nature of natural processes—views which have been developed in the nineteenth century. As an example, let a local increase in pressure be produced in the air by, say, an explosion. This increase in pressure tends to equalize itself, and the excess of pressure moves through the air as

sound. From the assumption that sound is a wave movement in an elastic medium like air, Newton and Laplace calculated its velocity accurately as 330 meters per second.

That sound is a vibratory movement is not theory but fact. In other regions, however, we have only theories as to the nature of the phenomena. We have had to distinguish between matter and ether; the former consisting of very small, perfectly elastic parts, which are different for each element; the latter, a medium everywhere present, penetrating everything. The ether is the carrier of all radiation, as for example, light.

Let us trace the development of the views concerning light. According to Newton light was produced by light particles which moved with great velocity. The discovery of interference by Fresnel at the beginning of this century showed that light was a wave motion, as Huyghen's had supposed. The vibrations took place in the ether, and light moved with a velocity about one million times that of sound. In order to explain the phenomenon of polarization it was necessary to assume that the vibrations are transverse and not longitudinal.

The view that the ether is a simple elastic medium could not account for the relations between light, electricity and magnetism. Those substances which are the best conductors of electricity, as the metals, are opaque to light; while glass, which is transparent to light, does not conduct electricity. Relations such as these led Maxwell, Helmholtz and others to the assumption that the vibrations in the ether are of an electrical nature. This was the origin of the electromagnetic theory of light. In terms of this theory, light is only an electromagnetic vibration of the ether of very small period. The number of vibrations per second is about 400 billions for red and 800 billions for violet light. But there is still an infinite field for slower and also for more rapid vibrations, and here we meet with the greatest discoveries of the nineteenth century. The somewhat slower vibrations are heat rays; the somewhat more rapid are chemical rays; the still more rapid are the Röntgen rays, corresponding to the Helmholtz very rapid electromagnetic vibrations; while the very slow vibrations (about 100 million per second) are the Hertz waves. These electrical vibrations behave just like light, only they are invisible. They find application in wireless telegraphy.

The assumption is, therefore, plausible that light also is produced by electrical vibrations of the charged atoms or ions in the source of light. This is confirmed by the discovery of the Zeeman effect.

Let us now turn to chemistry. Substances like potassium and sodium, which at the beginning of the century were regarded as elementary, have been decomposed by Davy. The remaining elements have, however, maintained their elementary nature, and about 80 are now known. That an organic connection exists between the elements has been shown by Newlands, Lothar Meyer and Mendeleff. In terms of this relation new elements have been predicted and they have since been discovered by Locoq de Boisbaudran, Winkler and Nilson. These elements are, of course, gallium, germanium and scandium.

The *synthesis* of compounds has been carried very far indeed. The synthesis of urea by Wöhler broke down the distinction between the compounds prepared in nature and in the laboratory. And we can now prepare optically active substances in abundance. Synthesis has reached its climax in the preparation of the artificial dyes. Graebe and Liebermann have made alizarin. Baeyer has effected the synthesis of indigo. Ladenburg of the alkaloid coniine, while

Emil Fischer has effected the synthesis of grape sugar.

It now only remains to make artificially the enzymes and albumens. Up to the present these require the intervention of life.

The most careful quantitative study of the transformations of matter have shown that mass remains unchanged. A definite quantity of every element was, is, and will be. This recalls the law of the conservation of work, and is perhaps connected with it.

The atomic hypothesis, which was proposed by Dalton as a convenient means of explaining the laws of definite and multiple proportions, has been given new meaning by Avogadro, and Kekulé, in terms of valence, has shown how the atoms are united in the molecule. Stereochemistry has even thrown light on the arrangement of the atoms in space, and Mitscherlich has shown that there are relations between the external crystal form and the atomic composition and constitution of the molecules.

The chemistry of the nineteenth century is also characterized by the introduction of physical methods and principles, which have almost always produced marked advances, and frequently fundamental changes. Among the physical methods should be mentioned the balance, the spectroscopic methods of Bunsen and Kirchhoff, and the electrical methods, which, in the hands of Clausius and Arrhenius have led to the theory of electrolytic dissociation.

The introduction of physical principles has also accomplished much. Bertholet, Guldberg and Waage have explained the facts of chemical equilibrium, showing that a transformation only proceeds to a definite limit. They have introduced the idea of general attraction, and have shown how the active mass can be ascertained. Thomsen and Berthelot have attempted to apply the law of the conservation of work to chemical problems, and have developed the principle, which, however, does not always hold, that the heat evolved in a reaction is a measure of the affinity.

Through the united efforts of mathematicians, physicists and chemists, chemistry has, then, been placed upon a sure foundation. The second law of thermodynamics has been applied to chemical processes first by Horstmann, and then by Gibbs, Helmholtz, Duhem and others. This is, however, difficult for the chemist, since it involves a fairly good knowledge of mathematics and physics. It is, therefore, the problem of the physical chemists to give their well-established fundamental principles the simplest possible form. Something has been already accomplished.

1. The laws of dilute solutions, involving the conception of osmotic pressure, are just as simple as those of dilute gases, indeed, they are identical with them.

2. The heat evolved in a reaction determines the direction in which the equilibrium will be displaced by change in temperature. That which is formed with evolution of heat comes more and more to the front with decrease in temperature.

3. Affinity is closely connected with the conception of free work and is measured, not by the heat developed, but by the electrical work developed (electromotive force). Of these three principles, special stress is to be laid upon the importance of the last.

A very brief discussion of the *concrete* or *special sciences* follows. These include astronomy, meteorology, geography and geology.

Astronomy, by means of the spectroscope, has shown that in the spaces, so distant that it requires light many years to reach us, there is the same kind of matter as here on the earth. This includes iron, hydrogen and about twenty other elements, and these obey the same laws of reciprocal attraction as they do here on the earth. Astronomy

also calculates the history of the world in the future.

Geology gives us similar knowledge of the past, and shows that the world has not developed by sudden changes, as was formerly supposed, but that it has developed in accordance with the same laws which now reign.

Harry C. Jones.

BUFO AGUA IN THE BERMUDAS.

One of the characteristics of the fauna of the Bermudas is the scarcity of terrestrial vertebrate forms. At present there is known but a single reptile (*Eumeces longirostris*) and a single amphibian (*Bufo agua* Daudin). In 1884 Jones and Goode ('Contributions to the Natural History of the Bermudas,' Bull. U. S. Nat. Mus.) recorded no amphibian. Heilprin ('The Bermudas,' Philadelphia, 1893, p. 84) says that in 1888 he saw a few individuals of *B. agua* in the salt marshes. As far as recorded, no amphibian had been known in the colony until the introduction of this species.

The history of its introduction, as gained from an interview with Captain Vesey in July, 1900, is as follows: Captain Nathaniel Vesey (at present a member of the Colonial Parliament from the parish of Devonshire) 'about fifteen years ago' engaged the master of a vessel plying between Hamilton and Demarara, British Guiana, to secure for him some of the Guianan toads, with a view to using them to catch garden insects. The toads were brought from Demarara to Hamilton, and were carried out to Devonshire by a native, who must have purloined some of the animals, for individuals were seen near the native's home (Tuckerstown), ten miles distant, soon afterward. Captain Vesey liberated 'about two dozen' individuals in his garden, where they thrived from the first and ate many insects.

From these two centers the animal has spread until it is common throughout the colony. In its search for moist places it often gets into the cisterns, fouling the water. This fact, together with its ugly appearance and the common opinion that it is venomous, has brought it into disfavor with the inhabitants.

The porosity of the rock permits no springs, streams or ponds in the islands. The only bodies of water are several brackish tidal ponds near the shore. There are some brackish marshes the salinity of which is less than that of the ponds, but which are by no means fresh. It is in these marshes that the animal breeds. It seems to have adopted these from necessity rather than from preference, for in Jamaica (Andrews) and in Brazil (Hensel) it spawns in fresh-water pools.

The eggs are extruded 'early in the spring,' according to local report, but this must be regarded as uncertain until we have better evidence. In Jamaica spawning is said to occur in October, and in Rio Grand do Sul, Brazil, in the middle of winter (June). In July, while at the Biological Station of New York University at Hamilton, I found large numbers of young, nine to fourteen millimeters long, in the grass and on the roads near the brackish marshes. They were especially abundant just after a shower.

Bufo agua is the largest living Anuran known. The largest specimen I have seen from Bermuda was collected by the New York University Expedition of 1898 and is now in the Zoological Museum at Columbia University. It measures 155 mm. from snout to vent, and weighs 960 gm. after having been two years in a four per cent. solution of formalin.

This toad is found in South and Central America and in the warmer parts of Mexico. It has not been included in the Neoarctic fauna by either Cope or Garman. I have found no record of it west of the Andes further south than Chimbo, Ecuador (about

2° S.). The expeditions to the Andes have not recorded it above altitudes of 1,500 feet nor more than about a hundred miles back from the coast. On the east coast it is recorded as far south as the Sierras del Tandel, Argentina (38° S.) by Berg. It is found throughout Brazil and in eastern Ecuador well up towards the headwaters of the Amazon.

It has been introduced into many of the Lesser Antilles to catch insects (Herrera). In 1844, according to Gosse, it was introduced into Jamaica from the Barbadoes, where it has been used to catch field rats. It had been brought from Martinique to Barbadoes, and had been carried to Martinique from Cayenne. It appears doubtful that it is indigenous to any of the islands with the possible exception of Trinidad. Faunal lists from Cuba, Porto Rico and the Bahamas do not include it.

Bermuda is now its northern limit, both in latitude (33° N.) and in mean annual isotherm (70° F.), but this distance from the equator is exceeded on the east coast of South America both in latitude (38° S.) and in mean annual isotherm (58° F.). It is essentially a tropical and subtropical form, and I do not find record of it in the region of frost in either latitude or altitude, except for a small area in Argentina.

Bufo agua is known by various local names. The natives of parts of Brazil call it aguaquaquan, from which comes its specific name. In Jamaica it is known as a 'bull-frog.' The inhabitants are prejudiced against it throughout its range and it is killed at every opportunity.

There is a general belief that it is venomous. One Brazilian writer (Filho) says that travelers report the use of its venom in place of curari by the natives of the upper Amazon region.

Experiments show that the secretion of its cutaneous and parotoid glands, when injected into the circulation of dogs, fowls or frogs has poisonous effects, and in moderate doses causes convulsions, followed by death. There is no evidence that mere external application causes more than a slight irritation unless it reaches mucous membrane, when ulceration follows, or the cornea, which is rendered temporarily opaque.

There is not sufficient evidence to substantiate the popular belief among the natives of Bermuda that the animal can eject its secretion to a distance. There is some evidence that the secretion when taken into the digestive tract—as in the case of a dog getting it into the mouth—will cause death in a few hours, but there are no careful records of the physiological effects of the secretion beyond the fact that subcutaneous injections cause tetanic convulsions, followed by death in from one-half to two hours, according to dose.

F. C. WAITE.
UNIVERSITY HEIGHTS, NEW YORK CITY.

SCIENTIFIC BOOKS.

Le préhistorique, origine et antiquité de l'homme. Par GABRIEL et ADRIEN DE MORTILLET. 121 figures dans le texte. 3e édition. Paris, Schleicher frères, 1900. Pp. xxii + 709. Bibliothèque des sciences contemporaines.

The first edition of *Le préhistorique* dates from 1883. A second edition appeared two years later and was exhausted at the end of ten years. The value of the work, as well as the rapid growth of the science, has made a third edition imperative. Gabriel de Mortillet devoted the closing year of his life to this task, which was destined to be completed by his son and collaborator, Adrien de Mortillet.

The incorporation of an immense amount of new and valuable material, made possible by a recasting of the work, has of necessity limited its scope. The Neolithic period is left to be treated in a separate volume together with the Bronze age.

The two main divisions of the present volume are devoted to the Tertiary and early Quaternary, respectively. The authors are inclined to make the most of the evidence bearing on a

Tertiary precursor of man, devoting twelve chapters to it. The accounts of the discoveries at Thenay, Saint Prest and Puy-Courny, in France; Otta, Portugal; Yenangyoung, Upper Búrma, and as core of others are faithfully reviewed.

The Calaveras skull is rejected. The deposit in which it was said to have been found is Quaternary instead of Tertiary, and the skull, besides being of doubtful origin, bears not a single mark of antiquity. Neither are the human remains from Olmo, Colle del Vento and Castenedolo, Italy, accepted as Pliocene.

The chapter on fossil monkeys closes with *Pithecanthropus erectus*, which is considered the immediate precursor of man. The authors conclude that while man did not exist during the Tertiary, there did exist precursors of man more intelligent than any of the living anthropoids.

Part second is devoted to the Early Quaternary, which, according to de Mortillet, corresponds to the Paleolithic period. The method of treatment here is less didactic than in the earlier editions, the subject matter being grouped under the following headings:

I. Industry, or Technology.
II. Man, or Anthropology.
III. Fauna, or Zoology.
IV. Flora, or Botany.
V. Geology.
VI. Geography.

The first successful attempt to establish a scientific system of relative chronology for prehistoric times was made by Thomsen of Copenhagen, in 1836. Of the subsequent writers who have contributed to the elaboration of Thomsen's triple division, Gabriel de Mortillet unquestionably ranks first. His classification is very generally accepted, and ought to be familiar to every one who wishes to keep abreast of archeological literature.

De Mortillet's system is based on the development of human industry, the successive steps of which are grouped under epochs. Following the method of nomenclature adopted by the geologist, he has given to each epoch the name of some well-known locality where the culture-stage in question is to be found in its purity.

The six epochs into which the Paleolithic period is divided, beginning with the oldest, are: Chellean, Acheulian, Mousterian, Solutréan, Magdalenian, and Tourasséan, the Acheulian and Tourasséan being regarded merely as epochs of transition.

After tracing the steps in the industrial evolution of the Paleolithic period, the authors pass in review all the discoveries of fossil human bones supposed to belong to the same period. The existence of two races is recognized —an earlier, referred to the first three epochs of the Paleolithic period and called Neanderthal, and a later, referred to the last three epochs of the same period and named Laugerian, or race of Laugerie-Basse. The Laugerian race is derived from the Neanderthal without intermixture from any foreign source. The transition may be traced in the human remains from Arcy, Eguisheim, Marcilly and Bréchamps.

Acting on the safe principle that it is better to discard correct testimony than to accept doubtful, of the 33 discoveries of human remains attributed to the lower half of the Paleolithic, 18 are discarded altogether, 4 are put in the doubtful list, and only 11 classed as authentic. Those accepted are: Neanderthal in Prussia, and Eguisheim in Alsace; La Naulette and Spy in Belgium; Tilbury and Bury Saint Edmunds, England; Denise, Marcilly, Bréchamps, Malarnaud and Arcy, in France. The doubtful are: Canstadt, in Würtemberg; Brüx, Bohemia; Schipka, Moravia; Hamilton, Ireland. Those to be discarded are: Nagy-Sap, Hungary; Brünn and Predmost, in Moravia; Podbaba, Bohemia; Stängenäs, Sweden; Gaylenreuth, Lahr and Bolwiller, Germany; Engis, Belgium; Maestricht, Holland; Kirkdale, Victroia Cave and Galley Hill, England; Moulin-Quignon, Clichy, Grenelle, Gravenoire and Estalas, France.

Of the human remains attributed to the second half of the Paleolithic period, the authentic are: the skeletons of Laugerie-Basse, Chancelade and Sorde inférieur, all in France. A number of finds, including Cro-Magnon, Furfooz and Baoussé-Roussé are classed as Neolithic sepultures.

Ten chapters are devoted to the contemporary fauna, and three to the flora. The question of the domestication of animals is decided

in the negative. There is also no evidence that the Paleolithic hunter-populations knew anything about agriculture.

A comparative study of the fauna and flora of France and England leads to the conclusion that the British Isles were united to the continent during the early Quaternary. The Seine, instead of reaching the sea at Le Havre, flowed westward along the coast of Calvados, then north and west past the site of the present city of Cherbourg, to empty into a gulf of the Atlantic separating Cornwall from Brittany. The Somme traversed rather obliquely the Channel, and being augmented on the way by affluents from both France and England, passed between the Isle of Wight and England by way of Spithead and the Solent, where it emptied into the same gulf of the Atlantic some distance north of the Seine.

It is interesting to compare this view with that of Sir John Evans,* Mr. Codrington and the Rev. W. Fox.† The latter agree among themselves, although their conclusions were arrived at independently. They agree with de Mortillet in one respect only, viz., the river orgin of the Solent. But in their opinion, that river flowed east and not west, joining the the sea at Spithead. It was not the Somme, but a considerable stream, some of whose tributaries still exist in the small rivers which form the drainage of Dorset and Wilts.

There was also, during the Chellean epoch, a junction of Europe with America by way of the British Isles, the Faroes, Iceland and Greenland.

The volume closes with the geographic distribution of the types of industry characterizing the six epochs of the Paleolithic period. The abundance of rudely chipped Paleoliths in North America is recognized, but they are not considered as synchronous with the Chellean epoch in Europe. The Trenton terrace is referred to the same epoch as the Mousterian station of Santerno, Italy, which corresponds to 'the grand extension' of the glaciers.

In conclusion, by applying an absolute chronometric scale to the adopted system of relative chronology, the following results are obtained:

Chellean epoch (preglacial)	78,000 years.
Mousterian epoch (glacial)	100,000 "
Solutréan epoch	11,000 "
Magdalenian epoch	33,000 "
Total	222,000 "

To the 222,000 years of early Quaternary is to be added 'the 6,000 years since the beginning of the historic period in Egypt and a probable 10,000 years of the Protohistoric and Neolithic.' The authors believe this to be a very moderate estimate for the antiquity of man.

There is a limit to the amount of matter that can be pressed into a single volume. The one in question is exceedingly rich as it stands, being far more comprehensive than any other attempting to cover the same field. Yet many will regret that so few references were cited and that a series of maps was not incorporated. The science of prehistoric anthropology is sadly in need of cartographic enrichment. It would be difficult to conceive of a more fruitful source for such an enrichment than the combined knowledge of the de Mortillets.

We may, however, hope that the desired maps, augmented by others, will be included in the promised additional volume. May it soon appear!

GEORGE GRANT MACCURDY.

Analyse des Gaz. By M. E. POZZI ESCOT. Paris, Gauthier-Villars. 1900. Pp. 200.

Chapter I., on 'Sampling,' is by far the best in the book, being complete and well written; the writer regrets that the same can not be said of the following chapters. In the important branch of analysis by explosion not one of the later forms of explosion pipette is given. In Chapter III., on reagents, no mention is made of fuming sulphuric acid, which Winkler showed ten years ago to be the best absorbent for 'heavy hydrocarbons'; nor is any statement made of the limitations of the use of various reagents, nor of their capacity of absorption.

Chapter IV., on the analytical characters and methods of estimating the principal gases, might almost—as far as any special information about gas analysis is concerned—have been taken from any treatise on chemistry.

Chapter V., on qualitative analysis, is admirable.

*'Ancient stone implements of Great Britain,' 2d edition, p. 690.

† *Geologist*, Vol. V., p. 452.

In Chapter VI., on the analysis of gaseous mixtures, especially by combustion, no directions or precautions are given necessary for a successful result, nor is the treatment of the analysis of illuminating gas at all satisfactory.

Chapter VII., on gas analytical apparatus, describes in a general way a number of the important forms of apparatus.

Chapter VIII., on the calorific power of gases, is especially disappointing, the only methods given being that of Mahler—by the bomb, and by calculation, no mention being made of the excellent apparatus of Junkers.

In conclusion, the work, so far from being 'essentiellement pratique,' as reviewed in the *Comptes Rendus*, appears to be superficial, better adapted to give a general idea of the subject than for a laboratory manual.

Augustus H. Gill.

SCIENTIFIC JOURNALS AND ARTICLES.

The American Naturalist for January begins with a list of 'Plants used by the Indians of Eastern North America,' by Lucia B. Chamberlain. The plants are arranged in alphabetic order under the name of each of the tribes considered and the uses of the plants are noted. R. W. Shufeldt has an article 'On the Systematic Position of the Sand Grouse (*Pterocletes; Syrrhaptes*),' concluding that they belong where they are usually placed, between the Galli and Columbæ. G. H. Parker discusses 'Correlated Abnormalites in the Scutes and Bony Plates of the Carapace of the Sculptured Tortoise,' concluding that there is a more intimate relation between the plates and scutes than has been generally admitted. Roswell H. Johnson describes, with outline and skiagraph illustrations 'Three Polymelous Frogs' and C. H. Eigenmann and Ulysses O. Cox consider 'Some Cases of Saltatory Variation.' James Perrin Smith treats of 'The Larval Coil of Baculites' and deduces that Baculites probably originated from *Lytoceras*, and some 'Variation Notes' are given, taken from the *Bulletin of the Société d'Anthropologie.* The Editor announces that the 'News' department will be discontinued as the same field is covered by Science more promptly, but that the record of appointments, retirements and deaths will be continued and that there will be added notices of gifts to educational institutions, all to be published quarterly.

SOCIETIES AND ACADEMIES.

SECTION OF ASTRONOMY, PHYSICS AND CHEMISTRY OF THE NEW YORK ACADEMY OF SCIENCES.

A regular meeting of the Section was held at 12 West 31st Street, New York, on February 4, 1901. Professor George E. Hale, director of the Yerkes Observatory, gave a lecture on 'Astronomical Photography with a Visual Telescope.' The following is an abstract:

Photography was discovered in 1837, and the first astronomical photograph was taken in 1840 by Dr. Draper of New York. It was a photograph of the moon made on a daguerreotype plate, and gave great promise of future work. Bond in 1850 made the first photograph of the stars. Rutherfurd of New York, in 1858, made some remarkable photographs of the moon, and later some star photographs.

Photography has now become so valuable in astronomy that it is applied in every department. It is not true, however, that it will displace the eye. There are certain fields where the eye will be superior to the photographic plate, but in many other fields photography has led to results that never could have been obtained by visual observation. I shall speak tonight of work done at the Yerkes Observatory with a telescope designed for visual observation. It is fortunate that this telescope was not designed for photography alone, for by the use of methods recently devised it has been possible to use it for photography and the results are not at all inferior to what they might have been on a telescope designed for photography alone.

The forty inch telescope of the Yerkes Observatory can be considered as a long camera with a focal length of about sixty-four feet. Its field of view embraces a circle in the sky of only about five minutes of arc in diameter. In photographing groups and clusters of stars this long focal length makes it possible to separate stars which would have been run together into one mass with an instrument of shorter focal length. A means of counteracting the uncor-

rected chromatic aberration has been devised by Mr. Ritchie of the Yerkes Observatory. He employs a yellow collodion film in front of the photographic plate at the eye end of the instrument, by which the blue rays are cut off. Suitable isochromatic plates, such as can be found on the market, are used. This is a very inexpensive means of using the telescope for photography. A special form of guiding apparatus to keep the star image at the same point of the plate has to be employed. On account of the unavoidable flexure of the large telescope tube, an auxiliary telescope placed parallel to the telescope tube cannot be used. The image of another star just outside the photographic plate is made use of. By means of a little eyepiece with a fine pair of cross-hairs, attached to the plate holder which is adjustable in two directions at right angles to each other, the image of the guide star is kept on the intersection of the cross-hairs during the entire time of the exposure. The photographs taken at the Yerkes Observatory in this manner by Mr. Ritchie are much finer than those taken at Potsdam with a photographic telescope.

A most important application of photography with this telescope will be the determination of the parallax of stars, which has not yet been done to any extent by photographic means.

Photographs of the small planetary nebulæ taken with this telescope show more than can be actually seen with our eyes, as in some cases a radial structure.

The instrument can also be used to study stellar spectra and stellar evolution. We can pass by gradations from the type of hot and white stars like Sirius, to the more developed and colder ones like our sun, and then to the red stars. There are two types of red stars, and by the aid of their spectra photographed with this telescope, we have detected a relationship between the two types, through the presence of carbon bands. Even in the atmosphere of the sun there is a very thin layer of carbon vapor and above this the gases of the chromosphere. In the red stars we have this carbon vapor, which is very dense in one of the types.

Another important line of work is that of measuring the motion of stars in the line of sight. Professor Frost uses the titanium line for this purpose, and has just had a new spectrograph constructed for the work.

In photographing the spectrum of Saturn with its rings, we find a faint band in the red indicating the presence of a comparatively dense absorbing atmosphere on the planet which is absent from the rings.

With the help of a spectroheliograph we are able to photograph solar phenomena. These photographs show that the mottling of the sun's surface persists throughout the minimum period of sun spots as well as through the maximum. Prominences can be photographed nearly as well with it as at times of total solar eclipse.

Mr. W. G. Levison presented a 'Note on a Cause of the Deterioration of Gelatin Photographic Dry Plates.' The author suggests that there is some emanation, probably Becquerel rays, from the pasteboard of the boxes in which the plates are packed for the market, which causes their deterioration. He found that if he cut a star from the pasteboard of a plate box and laid it on the sensitive side of a plate, the whole then being enclosed in a box for a week, when he developed the plate he obtained an image of the star. This would explain the deterioration at the edges of plates where they come nearly in contact with the box, or the deterioration due to the pasteboard separators at the edges of the plates. The author's experiments led him to the suggestion that metal boxes would be better for the plates than the pasteboard boxes. Wrapping with paraffine paper might also have the same effect.

WILLIAM S. DAY,
Secretary.

TORREY BOTANICAL CLUB.

AT the annual meeting, January 8, 1901, the Secretary, Professor E. S. Burgess, reported 15 meetings held during the year, with an average attendance of 38; 19 active members were elected. The active membership is now 238, the total membership 383; 20 papers have been presented, with addition of 26 brief notes of collections or of botanical progress.

The editor, Professor L. M. Underwood, reported a continued increase in the number of pages and of plates in the Club's publications,

including in Volume 27 of the *Bulletin*, 666 pages and 33 plates, and including Volume 9 of the *Memoirs*, with 292 pages and 9 plates. The articles printed in the *Bulletin* have numbered 63, by 48 different persons; 19 articles have contained descriptions of new species among the higher plants.

The Club voted to begin the publication of an additional monthly of about 12 pages, to include botanical notes and jottings, with reference to the local flora and to other subjects, and to bear the name *Torreya*, in honor of Dr. John Torrey, founder of the Club. Dr. M. A. Howe was made editor. The pressure of more extended technical matter upon the pages of the *Torrey Bulletin* has so far developed as to crowd out minor and more popular notes, and it was thought desirable to provide an opportunity for them by the establishment of this new journal, *Torreya*, which will be sent free to all Club members; to others at one dollar.

The officers elected for 1901 include the following: *President*, Hon. Addison Brown; *Treasurer*, Dr. H. B. Ferguson; *Recording Secretary*, Professor E. S. Burgess; *Editor*, Professor L. M. Underwood; *Associate Editors*, Dr. C. C. Curtis, Dr. M. A. Howe, Professor F. L. Lloyd, Dr. D. T. MacDougal, Dr. H. M. Richards, Miss Anna Murray Vail, Dr. N. L. Britton.

Recent papers read include Mr. J. E. Kirkwood's studies on the embryology of the Cucurbitaceae, the types selected for comparison being *Sicyos angulatus*, L., *Micrampelis lobata* (Michx.) Greene, and *Mornordica charanta*, L. These three types resemble one another in some features of their earlier development; in each case a cup-like structure is formed on the inner side of which the ovules are differentiated. In each case the normal definite embroyo-sac is a typical one. Some ovules of *Sicyos* exhibited an embryo-sac abnormally developed. Endosperm is formed soon after fertilization, and seems to have the function of digesting the tissue of the nucellus and supplying the young embryo with food material. No suspensor was found in *Sicyos*, but in *Micrampelis* and *Mornordica* it is usually formed with two or three cells.

Edward S. Burgess,
Secretary.

DISCUSSION AND CORRESPONDENCE.

THE SUPPOSED TERTIARY SEA OF SOUTHERN BRAZIL.

In an article entitled 'The History of the Neotropical Region,' published in No. 310 (Dec. 7, 1900) of Science, Dr. H. von Ihering, in order to account for certain zoogeographical facts reported by him, proposes the somewhat startling hypothesis of a tertiary sea separating two faunal sub-regions that he denominates 'Archiplata' and 'Archamazonia,' and gives the purely zoological evidence as sufficient, in his opinion, to positively establish the existence of this important geological feature. As the boundaries of these faunal sub-regions are not clearly defined the position of this sea remains doubtful, but from the context it is clear that it must have tied in with the known marine tertiary deposits of the Argentine province of Entre Rios and extended across the present mass of Brazilian highlands in such a way as to leave in the southern division a great part, if not all, of the States of Rio Grande do Sul and Santa Catharina, that is to say, in some part of the present basin of the Rio Uruguay.

Unfortunately our knowledge of the geological structure of this portion of Braziliian territory is extremely defective, but enough is known to make it certain that a presumably pre-tertiary formation stretches entirely across the region in question and thus far no geological observations or topographical features are known that suggest the slightest suspicion of any important break in its continuity. This is a formation characterized, like the triassic belt of eastern North America which it much resembles, by dykes, intercallated sheets and outflows of trappean rocks (diabase-porphyrite of Rosenbusch) of very uniform mineralogical composition, but very varied physical structure and aspect, by means of which it can readily be traced. Its geological age is undetermined, except that it is almost certainly post-paleozoic, since it overlies permian beds containing the Glossopteris flora. From this circumstance and from the strong resemblance to the above mentioned North American region, it has generally been referred to the triassic, though there is nothing to prove that it might not be cretaceous

or even tertiary. To refer it to the latter age would not, however, help the hypothesis here discussed, since there is no evidence whatever of its being of marine origin, and its northward extension well into the heart of central Brazil makes it embrace a very considerable portion of the Archamazonia faunal region of Dr. von Ihering.

The heavy trap dykes and sheets of this formation give very marked topographical features (lines of escarpments and obstructions in rivers) by which it can be traced even in regions that have not been geologically examined, and for some years I have occupied myself in tracing its distribution through such chance information and specimens as were obtainable from regions not personally known to me. Particularly valuable for this purpose was the material which for years has been accumulating in the Museum National of Rio de Janeiro and which for the region under discussion is especially important and authentic, since it contains a complete duplication of the material collected by Sellow on which Weiss' paper, the most important that has yet appeared on the geology of Rio Grande do Sul and Uruguay, was based. Without going into detail, suffice it to say that there is evidence that I consider sufficient to establish the general fact that this formation extends without a break and in the form of a great tableland, from 600 to 1,000 meters high, from near the headwaters of the Paraná in southern Goyaz and western Minas Geræs to the line of escarped hills that cross nearly in the middle, the State of Rio Grande do Sul from east to west. To the south of this line, which seems to be a giant fault, the formation lies lower and has been much denuded, so that it is frequently interrupted by areas of older rocks appearing from underneath, but thus far no evidence whatever has been presented of the occurrence of any overlying formation of marine origin.

Of special significance for our present purpose is the fact that the falls and rapids of the river Uruguay, down to the Brazilian limit and beyond, are composed of the hard traps of this formation which would thus present a barrier to the sea which in tertiary times undoubtedly occupied a part of the Argentine province of Entre Rios. The only point where the deposits of this sea are known to extend to the eastern bank of the Uruguay is near the town of Colonia, too far south to suit the hypothesis here discussed. Topographically considered, the only line in which there was a possibility of a break across this barrier is a depressed area in front of the above mentioned line of escarpments, occupied by parts of the valleys of the rivers Ybicuhy, flowing westward to the Uruguay, and Jacuhy, flowing eastward to the Atlantic. These two valleys are, however, separated by a considerable spur that unites like an isthmus the highlands of the upper Uruguay basin with those of southern Rio Grande do Sul and Uruguay. Thus far no evidence has been presented that this isthmus was ever submerged, or that the depressed portions of the Ybicuhy and Jacuhy valleys are occupied by other than fluvial deposits. It is quite possible that in secondary or tertiary times an arm of the sea may have extended into the region of the lower part of the present Jacuhy valley, but if so there is slight probability that it extended westward into those of the Ybicuhy and Uruguay, and even if such a connection be admitted it could only have been a narrow strait quite incapable of producing the 'collosal' faunal difference that it is attempted to explain. Speculation as to the probable existence of this strait is, moreover, quite gratuitous, since, if I rightly understand Dr. von Ihering, its position is entirely within his Archiplata sub-region.

ORVIILLE A. DERBY.

SÃO PAULO, BRAZIL,
Jan. 8, 1901.

GEOLOGICAL MAP OF EUROPE.

WHAT has become of it? Why does Dietrich Reimer not publish it?

WM. A. INGHAM,
Ex-Secretary Penna. Geol. Survey.

NOTES ON INORGANIC CHEMISTRY.

ROCK FORMATION.

AN important contribution to the study of solid solutions has been made by Professor W. Spring in the *Revue Générale des Sciences*, under the title of 'The Plasticity of Solid Bodies and

its Connection with Rock-Formation.' Experiments were carried out to determine whether under the influence of great pressure solid particles, which do not under ordinary circumstances unite, might be made to cohere. The pressure used in the experiments was about 10,000 atmospheres, and this pressure could be exerted if necessary at a temperature as high as 400°. All bodies which are plastic under pressure were found to cohere as if they had been fused, while those substances which are not malleable remained in a powder after exposure to the greatest pressures. Thus sand, calcium carbonate, alumina and oxid of iron did not cohere, and since the pressure used corresponds to a column of sand fifty kilometers in height, pressure alone can not be the cause of the formation of rocks from these materials. Metallic powders, on the other hand, cohere perfectly, which must be due to a kind of solid solution. That this is probable is shown by using mixtures of different metals, in which case alloys are formed as perfectly as by fusion. Those metals, however, which do not alloy by fusion, as lead and zinc, will not alloy under pressure. That these alloys were not occasioned by a mere mixing under pressure was shown by placing together without pressure cylinders of the same and of different metals. Even in the cold there was some adherence and, when heated to a temperature far below the point of fusion, a perfect union was obtained in a few hours. In the case of the union of different metals, an alloy was formed at the line of junction, which with tin and lead was six millimeters in thickness. Compounds were readily formed by pressure in those instances where the volume of the compound is less than that of its constituent elements, as with silver and sulphur; on the other hand, compounds which occupy more space than their constituents were dissociated by pressure. Thus copper calcium acetate was decomposed into copper acetate, calcium acetate and water. In those cases where solution is accompanied by contraction, the presence of water was found to greatly assist in the formation of solid masses from the powders, and solid carbonates were readily formed. A solution of silicic acid alone did not cause agglutination of sand, owing to the great contraction on drying, but when combined with even low pressure, solidification to a considerable extent was obtained. All these influences have played a part in rock formation.

ARSENIC IN COPPER.

Little is given in chemical literature regarding the effect of small quantities of arsenic upon copper, a subject of much importance at the present day. A series of experiments is described by Ernest A. Lewis in the *Chemical News*, in which arsenic was added to a copper 99.843 per cent. pure, and the resultant metal studied photomicrographically and as to its physical properties. Malleability is not appreciably affected by small quantities of arsenic (up to 1.8 per cent.), the samples with 1 per cent. and with 1.37 per cent. rolling particularly well. The tensile strength is from 3 to 5 tons higher than that of ordinary sheet copper, the limit of elasticity is about 3 tons per square inch higher, and the elongation is not reduced. From micrographical examination, the metal appears to consist of crystals of copper, in a eutectic of copper arsenid or a solution of copper arsenid in copper. In copper intended for rolling, except that for electrical purposes, the presence of a small amount of arsenic appears to be a distinct advantage, but nothing is gained by having more than 0.5 per cent. present.

ATMOSPHERIC HYDROGEN.

An interesting result of Professor Dewar's latest experiments, in conjunction with Professor Liveing, on the more volatile of the inert gases of the atmosphere is the demonstration that hydrogen exists free in the atmosphere in sensible proportion. There has been much question in the past as to its presence, which has not been heretofore satisfactorily proved; indeed the velocity of the hydrogen molecule renders it doubtful as to whether hydrogen would not escape from the earth into interplanetary space. On this basis there must be a continual accession of hydrogen to this planet from the interplanetary space, and hence possibly of the elements which occasion the lines of the nebular and coronal spectra. Some indications in this direction have been found in the atmospheric inert gases, and these are now being studied from this standpoint. J. L. H.

CURRENT NOTES ON PHYSIOGRAPHY.

THE CASCADE MOUNTAINS.

THE Cascade mountains are genetically described by I. C. Russell (A Preliminary Paper on the Geology of the Cascade Mountains in Northern Washington, 20th Ann. Rep. U. S. Geol. Surv., 1900, pt. II., 83–210; 10 pl., 3 maps) with such success as to give much support to rational or explanatory methods in place of the absolute or empirical methods that have long prevailed. Instead of being a sharp crested uplift, the mountains constitute a plateau, believed to have been produced by the elevation of a peneplain, but now maturely dissected. The area described, from 100 to 150 miles wide east and west, and of greater but unknown length north and south, seems to have been once a nearly flat-topped dome, 7,500 to 8,000 feet in altitude, composed of greatly disordered rock masses, whose tilted strata had been broadly truncated by long-continued erosion when the whole region stood lower. The uplift of the dome is given a late Tertiary date, because the sediments and lavas of the Columbia basin are tilted up along the eastern slopes of the elongated dome; here landslides, to be counted not by hundreds but by thousands, have occurred along the escarpments formed by the resistant lava sheets overlying weaker sediments. The granite mountains about Lake Chelan and the dissected volcano known as Glacier peak overtop their surroundings; the former are thought to owe their height not so much to resistant structure as to local uplift in excess of their neighbors. (An alternative explanation is offered, but discarded, to the effect that the ancient peneplain lay at the level of the granite summits 2,000 or 3,000 feet above the present skyline.) It is explicitly stated that no remnants of the uplifted peneplain are to be seen to-day in the form of even uplands at mountain-top height; dissection has everywhere advanced so far as to leave only sharp ridges between deep valleys. The work of the glacial period is indicated in countless cirques or corries, whose floors were so far widened that the spurs between them became sharply serrate; by numerous trough-like main valleys, with hanging lateral valleys; by lakes and moraines. The depth to which certain valleys, like that of Lake Chelan, have been eroded is taken to prove that the region stood about 1,000 feet higher than now in preglacial time; the capacity of glaciers to over-deepen their valleys not being accepted.

THE GLACIER OF MT. ARAPAHOE.

W. T. LEE describes 'The Glacier of Mt. Arapahoe, Colorado' (*Journ. Geol.*, VIII., 1900, 647–654, 2 pl.) as occupying a cirque opening to the north beneath a summit whose altitude is 13,520 feet. The front of the ice shows a stratified structure, and crevasses are believed to break its surface, while a moraine follows its front, and a stream, whitish with rock flour, issues from its base. The valley into which the cirque opens has a broad floor and precipitous sides; it holds several small lakes, sometimes in rock basins, sometimes behind barriers of waste. Evidently the existing glacier is a small affair compared with the ice stream that once stretched down the valley towards Boulder creek.

RHINE, DANUBE AND NECKAR.

THE depredations committed by the Rhine and its large branch, the Neckar, on the headwaters of the Danube, already somewhat studied by others, are clearly set forth by Penck

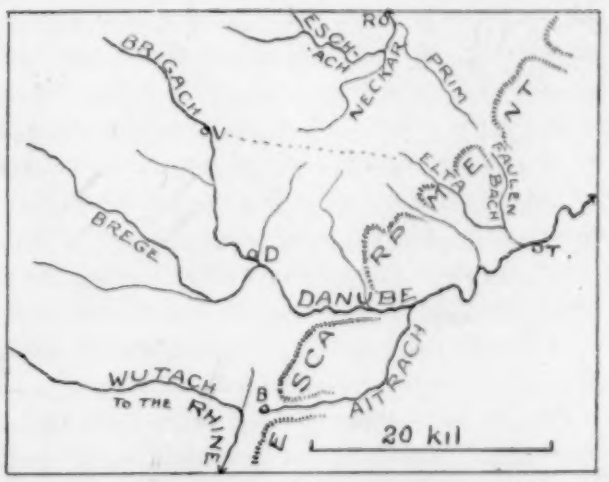

FIG. 1. Headwaters of the Danube between those of the Rhine and the Neckar. *B*, Blumberg; *D*, Donaueschingen; *R*, Rottweil; *T*, Tuttlingen; *V*, Villingen.

(Thalgeschichte der obersten Donau. *Verein f. Geschichte des Bodensees u. s. Umgebung*, 1900?). He shows that several ancient consequent streams flowing down the eastern slopes of the Black forest entered the Miocene sea of the

Bavarian foreland; and that as the sea withdrew the Danube was developed along its trough, engrafting into its trunk the many smaller streams that before had independent courses. As the valleys of the consequent streams were deepened, trenches were cut through the resistant strata of the white Jura, whose retreating margin was in time worn back (southeast) to form a cuesta with an infacing escarpment, while an inner lowland was opened on the weak Lias beds between the escarpment and the crystallines of the Black forest. To-day only one of the consequents (Brege-Danube) retains its course through the cuesta. The Wutach has been diverted from the Aitrach to the Rhine; the Brigach has been captured from the Elta by the Danube itself; and the Neckar has taken the Eschach from the Faulenbach. Similar changes are known for a long distance northeast of the Eschach, where the phenomena associated with the drainage of cuestas are illustrated in great variety. Penck uses the terms *Folgefluss*, *Schichtfluss* and *Gegenfluss* for consequent, subsequent and obsequent streams.

W. M. Davis.

CURRENT NOTES ON METEOROLOGY.

A NOTABLE STUDY OF ECLIPSE METEOROLOGY.

In his paper on 'The Eclipse Cyclone and the Diurnal Cyclone' (*Proc. Amer. Acad. Arts and Sci.*, XXXVI., Jan., 1901, 307–318) Clayton has gone far ahead of all previous investigators of the phenomena of eclipse meteorology. Hitherto, as a general rule, we have had little more than a few scattered observations of temperature, pressure, wind direction, etc., taken during an eclipse, and tabulated, with a brief summary of the results. In his study of the meteorological data obtained in connection with the total solar eclipse of May 28th last, Clayton has derived results of far-reaching importance, which throw light on two of the largest problems in meteorology.

The meteorological changes due to the eclipse were first separated from other changes, such as the diurnal and the cyclonic, and were then plotted on maps of the United States for 8.15 and for 9 A. M., May 28th, 75th meridian time. These maps show that the winds were practically reversed in direction as the umbra moved from one side of the continent to the other, both maps showing a distinct anticyclonic circulation and an outflow of air extending from the umbra to a distance of about 1,500 or 2,000 miles. The temperature depression due to the eclipse appears on the 9 A.M. chart as an oval area. At the central portion of this area the depression exceeds 8° Fahr., and this area of greatest cold lags behind the umbra about 500 miles. A third chart was constructed by plotting the stations at their proper distances from the path of the umbra, and plotting the successive 15-minute observations at intervals of about 500 miles, the result being a synoptic chart showing the conditions observed at any station or group of stations when they were in different portions of the eclipse area. This synoptic chart indicates distinctly an anticyclonic circulation of the wind around the center of the eclipse, extending out to a distance of about 1,500 miles from the umbra. Beyond this there are indications of another ring of outflowing winds. The isotherms show an elliptical area of cold air (inner isotherm 6° Fahr.) central about 500 miles in the rear of the umbra. There was a rise of absolute and of relative humidity during the eclipse, the shape and position of the areas showing the humidity departures being very similar to those of the temperature. The pressure changes in this eclipse, and in other eclipses, show that in normal eclipses there is a central area of relatively high pressure; surrounding this a ring of minimum pressure, and beyond this, outside the edge of the penumbra, is a ring of maximum pressure.

The low temperature, the circulation of winds and the form of the pressure curve, all proclaim the development by the eclipse of a *cold air cyclone*, as described by Ferrel. Mr. Clayton points out that the eclipse may be compared with an experiment by Nature in which all the causes that complicate the origin of the ordinary cyclone are eliminated, except that of a direct and rapid change of temperature. The result shows that a fall of temperature is capable of developing a cold-air cyclone in an astonishingly short time, with all the peculiar circulation of winds and distribution of pressure which constitute such a cyclone. The fall of temperature acts primarily to cause a cyclone, and

the anti-cyclone is a secondary phenomenon—a part of the cyclone. The eclipse cyclone, to keep pace with the eclipse shadow, must continuously have formed within the shadow, and must have dissipated in the rear almost instantly. The motion may thus be considered to have a certain analogy to wave mo ion.

In the light of his discovery that the brief fall of temperature in the eclipse can produce a well developed cyclone, which accompanies the eclipse shadow at the rate of about 2,000 miles an hour, Clayton believes that the fall of temperature due to the occurrence of night must also produce, or tend to produce, a cold-air cyclone. Since the heat of day produces, or tends to produce, a warm-air cyclone, there must tend to occur, each day, two minima of pressure, one near the coldest part of the day and another near the warmest part of the day, with areas of high pressure between them due to the overlapping of the pericyclones surrounding the cold-air and the warm-air cyclones, respectively. These causes must, in the opinion of the author, produce entirely, or in part, the well-known double diurnal period in air pressure, a question which has long puzzled meteorologists and for which as yet no wholly satisfactory explanation has been offered. The surface winds at Cordoba (Argentina) and at Blue Hill are in general found to be in opposite directions, and to indicate a circulation of the wind around two cyclonic centers passing along the equator, and an outflow from high pressures half way between them.

Clayton's conclusions, which are to be presented in greater detail in a forthcoming *Bulletin of the Blue Hill Observatory*, are of the greatest interest and importance. His explanation of the diurnal variation of the barometer seems to have in it many evidences of being the best yet offered to account for this puzzling phenomenon. Meteorologists will now look forward to future solar eclipses with greatly increased interest because of the importance which Mr. Clayton has shown to be attached to eclipse meteorology. It is to be hoped that Mr. Clayton may have the time and the opportunity to extend his investigation further in connection with previous eclipses.

R. DEC. WARD.

THE MAGNETIC SURVEY OF THE UNITED STATES.

ON July 1, 1899, a special division of the Coast and Geodetic Survey Office was created by the Superintendent to take charge of the magnetic survey of the United States and the countries under its jurisdiction, which up to that time had been conducted under the supervision of the Computing Division of the Coast and Geodetic Survey. Since that date magnetic observations, namely, declination, dip and intensity of magnetic force, have been made up to December 31, 1900, at about 500 stations distributed over the United States, Alaska and the Hawaiian Islands. At most of the stations permanent marks have been established for the use of the surveyor. Special consideration has also been given to the needs of the mariner, especially in Alaskan waters, where occur places of pronounced local attraction, affecting the compasses on board ship all the way from one-fourth of a point to four points.

Special stations known as 'repeat,' or 'secular variation' stations, have also been established in different parts of the country. At these, observations will be repeated at stated intervals in order to determine the amount of secular change in the magnetic elements. It is the endeavor whenever possible to establish such stations in the vicinities of colleges and universities, as experience has shown that on college grounds we may hope for a permanency of station for a fairly long interval.

Of special state surveys mention may be made first of the completion of the magnetic survey of Maryland, which was undertaken primarily by the Maryland Geological Survey, with assistance rendered by this Bureau; second, the completion of the magnetic survey of North Carolina, conducted under the joint auspices of this Bureau and the North Carolina Geological Survey; third, the completion of the magnetic survey of West Virginia, and fourth, the completion of the magnetic survey of Iowa.

Fair progress has also been made in the establishment of the Magnetic Base Stations, where the countless variations of the earth's magnetism will be recorded photographically. Thus a temporary magnetic observatory has been in operation at Baldwin, Kansas, since

July 1, 1900, and the buildings for the primary, or principal Magnetic Base Station, located at Cheltenham, Md., 16 miles southeast of Washington, have been completed and the installation of the instruments is now taking place. Special declination readings from 7 A.M. to 4 P.M. have been made at Gaithersburg, Md., since March 22, 1900, and at Sitka, Alaska, since October 1, 1900. The sites for the Magnetic Base Stations at Sitka, Alaska, and near Honolulu, Hawaiian Islands, have been determined and preparations made for the erection of the buildings. It is intended to have these magnetic observatories completed in time for cooperation with the proposed Antarctic expeditions.

Special simultaneous observations have also been made on special days at various times, the purpose of these special observations being to determine over how large an area the variations as recorded at the Base Stations may be regarded as applying.

Various special investigations, both of an experimental and of a theoretical character, have been undertaken, and considerable attention paid to the thorough training of observers and to the proper correlation of the various magnetic instruments. During the fall of 1899 a set of Coast Survey magnetic instruments was compared with the standard instruments at the following foreign observatories: Kew, England; Potsdam, Germany; Pavlovsk, Russia, and Parc St. Maur, France.

The following publications have been issued: Appendix No. 9, giving a general report of the magnetic survey of North Carolina, and Appendix No. 10, on the magnetic work of the U. S. Coast and Geodetic Survey; both appendices appearing in the 'Report of the Survey for 1898–99.' Good progress has also been made with the new edition of the Coast and Geodetic Survey magnetic declination tables and Isogonic charts for the United States and Alaska for 1900, designed especially for the use of surveyors and mariners. There has also been issued recently Bulletin No. 41, giving a general summary of magnetic declinations and of secular variation tables in North Carolina.

T.

ADVANCE IN FORESTRY LEGISLATION.

One by one the different States are awakened to their duty in providing for the future of our forest supplies. The latest development is the introduction on January 23d of two bills into the Legislature of Michigan, which aim to place the two most needful foundation stones for the future State policy. One bill is a most comprehensive 'Forest Fire Protection Act'; the other recognizes the forest reservation policy by establishing a State Forest Reserve.

There had been previously (in 1899) created a Forestry Commission of three members, and the bills were undoubtedly drawn by that Commission with great care.

The Fire Bill is based, in general principles, upon that in existence in the State of New York, which the writer had formulated in 1885, but is improved in several directions. It provides an organization of town fire-wardens under district forest-wardens, with a single Chief Forest-Warden responsible to the Forestry Commission. It places responsibility carefully and, with rather too much prescriptive detail, tries to meet any possible case. The main improvement upon the New York State law, besides the greater coherency of the organization, is the manner in which the expense is distributed. The State pays the entire expense and then collects three-quarters of it from the counties involved, namely, one-half from the county in which the fire originated, the other half from the counties, in proportion to the area burned over in each. But, if neglect on the part of a fire-warden or a responsible county officer can be proved, the whole charge goes against that county. This provision should create a wholesome solidarity and watchfulness in the whole community.

The State Forest Reserve, or rather several reservations, are to be made up of 'delinquent tax lands' within certain districts of the southern peninsula. The area desirable to reserve is to be determined by the Forestry Commission; future tax sales are to increase this area in a similar manner, and also voluntary contributions by private individuals. A novel idea in favor of educational effort is introduced for the acquirement of additional lands

by these last means. Such grantors may, in their deed, provide 'a trust of the lands so deeded in favor of the State University or State Agricultural College, or both, whereby all income and revenue from the lands so deeded shall be paid to the beneficiary named in such deed, as a permanent endowment * * * for the purposes of its work in the line of forestry.'

The possession, care, control and management of the State Forest Reserve lands are vested in the Forestry Commission, as well as the administration of the trust lands, and ample powers and legal authority are given to the Commission to secure the greatest benefit from the Reserves. It shall not only investigate modern forestry methods, etc., but has power to cut, remove, sell and contract away any timber it deems desirable, opening the way to a rational forest management.

For the purpose of carrying on this practical forestry work, provision is made for a Chief Forest Warden with a salary of $2,000, which is rather small for a really efficient man; he is made superintendent of all Forest Reserve Lands, with a number of deputy forest-wardens, with salaries not to exceed $3.00 per day, and the fire-wardens to assist.

The conferment of sheriff's power upon the forest officers, the provision of penalties for various acts of trespass and methods of procedure are prescribed in greatest detail, and the sum of $25,000 for the first two years is set aside to carry out the program.

This legislation is undoubtedly the most comprehensive and carefully drawn which has so far been introduced in any of the states. Under it a properly constituted Commission, properly supported with appropriations, should certainly make a successful beginning in establishing a permanent State Forest Policy. A provision which would make the administration independent of annual appropriations later on, and make it rely on its income, in part at least, would be the next desirable step. The present Forest Commission, as is evident from the care with which these bills are drawn, would seem most excellently fitted for its task.

B. E. FERNOW.

SCIENTIFIC NOTES AND NEWS.

AT a meeting of the American Geographical Society, on February 20th, the Cullum Medal was conferred on Dr. T. C. Mendenhall in recognition of his services as Superintendent of the United States Coast and Geodetic Survey and as a member of the Alaskan Boundary Commission.

THE gold medal presented by the Royal Astronomical Society to Professor E. C. Pickering, director of Harvard College Observatory, on February 8th, was received by the United States ambassador, Mr. Choate, who made a speech in acknowledgment.

THE students of the University of California celebrated the 77th birthday of Professor Joseph Le Conte on February 26th. Professor Le Conte has just returned to Berkeley from a visit to Georgia.

THE Senate of the University of St. Andrews has resolved to confer the degree of LL.D. on Mr. Alexander Agassiz, of Harvard University, and on Dr. J. A. Ewing, professor of applied mechanics in Cambridge University.

MR. ALEXANDER AGASSIZ was entertained at a banquet given by the French Zoological Society on February 1st. Speeches were made by MM. Perrier, Delage and Blanchard, to which Mr. Agassiz replied.

THE University of Pennsylvania has conferred the degree of LL. D. on President Henry S. Pritchett, of the Massachusetts Institute of Technology, and the degree of D.Sc. on Rear-Admiral George W. Melville, engineer-in-chief of the United States Navy.

DR. J. K. REES and Professor H. M. Howe, of the departments of astronomy and metallurgy of Columbia University, have been decorated as Chevaliers of the Legion of Honor by the President of the French Republic for services in connection with the Paris Exposition.

AT the convocation of the University of Oxford, on February 12th, the degree of D.Sc., *honoris causa*, was conferred upon Oliver J. Lodge, LL.D., F.R.S., principal of the University of Birmingham. He was presented by Dr. Love, Sedleian professor of natural philosophy, who briefly sketched his career, his distinctions and his investigations.

THE fourth banquet of the Paris *Scientia* was given to M. Marey on January 14th. Speeches were made by MM. de Parville, D'Arsonval and Richet. M. Marey made a reply, in the course of which he called attention to the progress of the plans for the standardization of physiological instruments. It appears that the City of Paris has set aside a building where the commission may carry on tests.

THE Adams Prize for 1901, open to the competition of all persons who have at any time been admitted to a degree in Cambridge University, has been awarded to Hector Munro Macdonald, M.A., fellow of Clare, for an essay on 'Electric Waves.'

PROFESSOR A. D. MEAD, of Brown University, has been appointed a member of the Inland Fish Commission of Rhode Island, in succession to Professor H. C. Bumpus who resigned, owing to his removal to the American Museum of Natural History, New York City.

AT the meeting of the Paris Academy of Medicine on January 29th, M. Jaccoud was elected to the post of permanent secretary, vacant by the death of M. Bergeron.

PROFESSOR DAVID P. TODD, of Amherst College, will sail next week for Singapore, to observe the total eclipse of May 18th in the Island of Sinkop. Mrs. Todd will accompany the expedition to accumulate material for revising her work on 'Total Eclipses of the Sun,' a new edition of which was published by Little, Brown & Co. a year ago. A botanist, also possibly an anthropologist, will be attached to the expedition, which is expected to return in August.

WE learn from the *Electrical World* that Professor R. A. Fessenden and his corps of assistants, sent out by the Government to establish wireless telegraph stations down the coast, have completed the first installation off Roanoke Island, N. C. The station is not far from Cape Hatteras.

DR. FREDERICK A. COOK has returned to New York after having attended a meeting at Brussels of those interested in the publication of the reports of the Belgian Antarctic expedition.

PROFESSOR M. I. PUPIN, of Columbia University, delivered an address on February 13th before the Scientific Association of Johns Hopkins University, his subject being 'Recent Improvements in Long Distance Telephony.'

WE learn from *Nature* that Professor J. A. Ewing, F.R.S., has been elected a member of the Athenæum Club under the provisions of the rule which permits of the election of persons of 'distinguished eminence in science, literature, the arts or for public service.'

DR. J. W. L. GLAISHER, F.R.S., has been elected president of the Royal Astronomical Society of Great Britain.

THE following members of the Paris Academy of Sciences have been elected officers of the Bureau des Longitudes for the year 1901: *President*, M. le commandant Guyon; *Vice-President*, M. le général Bassot, and *Secretary*, Professor G. Lippmann.

THE following were elected president and members of the council of the Physical Society of London for the ensuing year at the annual general meeting held on the 8th inst.: *President*, Professor S. P. Thompson, F.R.S.; *Vice-Presidents*, Mr. T. H. Blakesley, Mr. C. Vernon Boys, F.R.S., Professor J. D. Everett, F.R.S. and Mr. J. Walker; *Secretaries*, Mr. H. M. Elder and Mr. W. Watson, Physical Laboratory, South Kensington; *Foreign Secretary*, Professor R. T. Glazebrook, F.R.S.; *Treasurer*, Professor H. L. Callendar, F.R.S., University College, Gower-street; *Librarian*, Mr. W. Watson, Physical Laboratory, South Kensington; *Other Members of Council*, Professor H. E. Armstrong, F.R.S., Mr. W. R. Cooper, Mr. G. Griffith, Mr. E. H. Griffiths, F.R.S, Mr. R. A. Lehfeldt, D.Sc., Mr. S. Lupton, Professor J. Perry, F.R.S., Mr. A. W. Porter, D.Sc., Mr. W. A. Price and Mr. R. Threlfall, F.R.S. Professor Willard Gibbs, of Yale University and Dr. Rudolph Koenig, Paris, were elected honorary fellows of the Society.

DR. JACOB GEORG AGARDH, the eminent Swedish phycologist, died at Lund, Sweden, on January 17th, aged eighty-eight years.

FRANCIS KENNEDY, PH.D., since 1898 professor of philosophy in the University of Colorado, died on February 19th of heart failure. Although but 26 years of age, Dr. Kennedy had done much research work, and

his last illness was brought on by too close study and attention to the work of his department.

THE House of Representatives has agreed to the Senate amendments to the Agricultural Appropriation Bill, reorganizing the Department of Agriculture in the direction explained in recent issues of this JOURNAL.

THE following amendment to the General Deficiency Appropriation Bill was introduced into the House of Representatives on February 21st, by Mr. Ray, of New York:

That facilities for study and research in the Government Departments, the Library of Congress, the National Museum, the Zoological Park, the Bureau of Ethnology, the Fish Commission, the Botanic Gardens and similar institutions hereafter established shall be afforded to scientific investigators and to duly qualified individual students and graduates of institutions of learning in the several States and Territories, as well as in the District of Columbia, under such rules and restrictions as the heads of the Departments and Bureaus mentioned may prescribe.

A joint resolution to the same effect was introduced in the Senate on February 18th, by Mr. Perkins and referred to the Committee on Education and Labor.

MME AZOULAY has endowed, at the University of Lyons, a lectureship for foreign men of science. Professor Forel, of the University of Zurich, lectured on this foundation on January 27th, and Professor Schreiner, director of the observatory at Potsdam, is expected to lecture next month.

GIFTS for public libraries, conditional on their maintenance, have been made by Mr. Andrew Carnegie, to the following towns: Schenectady, N. Y., $50,000; Marion, Ind., $50,000; Galesburg, Ill., $50,000; Mount Vernon, N. Y., $35,000; Cumberland, Md., $25,000 and Port Jervis, N. Y., $20,000.

THE Royal Institution, London, has received gifts of £50 each from Sir Frederick Abel and Professor Dewar for the fund for the promotion of experimental research at low temperatures.

A TELEGRAM was received at the Harvard College Observatory, on February 22d, from Dr. T. D. Anderson, at Edinburgh, stating that a new star had been discovered by him in the constellation Perseus. The position is R. A. $3^h\ 24^m\ 24^s$ and Dec. $+43°\ 34'$. Its magnitude on February 21st was 2.7 and its color bluish-white. This star was observed at the Harvard College Observatory through clouds on February 22d. It was then first magnitude. A photograph of this region taken on February 19th showed that it was then fainter than the magnitude 10.5. This result was confirmed by photographs taken on February 2, 6, 8 and 18, 1901.

WHILE making an examination of the copper deposits in the vicinity of La Barranea, Sonora, Mexico, Mr. J. Owen, assistant to Dr. E. T. Dumble, found two deposits of torquoise. They occur in what is regarded as the equivalent of the volcanic complex described as 'Trincheras.' The deposits at Turquoise, Ariz., are in similar rocks.

MICHIGAN has long been known as a producer of copper and iron, and, more recently, as a source of salt supply for the West and the middle West. Still more recently large quantities of the secondary product of salt—caustic soda, soda ash and sodium carbonate have been sent out from the various plants in the neighborhood of Detroit. This has stimulated the search for coal, and Michigan coal, mainly from the Saginaw Valley, is now largely used. Within the past year attention has been called to the numerous deposits of marl and clay suitable for the manufacture of Portland cement, in Southern Michigan, and this interest is being rapidly developed.

THE seventy-third annual meeting of the German Men of Science and Physicians will be held this year at Hamburg from the 27th to the 29th of September.

THE French Association for the Advancement of Science will hold its annual meeting this year at Ajaccio, in Corsica, probably about the middle of September, and will be presided over by Dr Hamy.

THE *British Medical Journal* states that an Italian Society of Biology has recently been founded on the initiative of Professors Albertoni, Antonelli, Bizzozero, Bonome, Borzi Briosi, Bufalini, Camerano, Celli, Cervello, Chiarugi,

DeGiaxa, Delpino, Di Vestea, Emery, Fano, Ficalbi, Foà, Fusari, Gaglio, Giacosa, Golgi, Grassi, Guarnieri, Luciani, Lustig, Marcacci, Marchiafava, Martinotti, Mattirolo, Mosso, Pagliani, Pavesi, Pirotta, Romiti, Roster, Schrön, Stefani, Tizzoni and Todaro. The first meeting of the Society will probably be held in Rome during the coming Eastertide. The object of the Society is to promote the study of the biological sciences and everything relating to the advancement and teaching of these. The Society will publish a bulletin giving an account of its proceedings. It is divided into eight sections as follows: anatomy, physiology, pathological anatomy, general pathology, pharmacology, hygiene, zoology and botany.

THE February meeting of the Faculty Science Club of Wellesley College was held in the library of the Whitin Observatory, the paper being by Dr. Eleanor Gamble, of the Department of Psychology, on 'Certain Data for the Classification of Smells.'

THE Royal Geographical Society held a meeting on February 12th in commemoration of the reign of Queen Victoria, who was for sixty-three years the patron of the Society. The chair was taken by the president, Sir Clements Markham, who read the first paper on 'Her Majesty's Connection with the Society and Interest in Geography and on Polar Exploration during her Majesty's Reign.'

PROFESSOR WILLIAM H. BREWER, of the Yale Scientific School, lecturing at New Haven on the Antarctic Continent on February 15th, said, according to the report in the New York *Times*, that "This, the seventh and last continent of the world, which for several hundred miles extends parallel to the Antarctic circle, offering an effectual barrier to further navigation south, a New Havener had the honor of discovering. He was Lieut. Eld of the United States Navy. The memorial tablet to Lieut. Eld, which now stands in the Grove Street Cemetery, reads that he was born in New Haven in 1814 and died of yellow fever on board the U. S. S. *Ohio* in 1850. He was a member of the exploring expedition sent into the Antarctic regions by the United States Government in 1838–42 under command of Capt. Wilkes." "At 10 A.M. on January 16, 1839," so reads the tablet, "Lieut. Eld cried out 'Land.' Turning to Lieut. Reynolds who stood by he pointed out the range of icebound cliffs, along which the expedition afterward skirted for several hundred miles before it was compelled to turn back homeward. The peak which Eld first discovered was named Eld's Peak. The Antarctic continent which has never been penetrated goes by the name of Wilkes Land." The date of the tablet, which reads January 16, 1839, was discovered to be erroneous by Professor Brewer, while he was preparing this lecture. In looking through the ship's log of the expedition he found the true date to be January 16, 1840.

REUTER'S Agency gives out the following interview with Captain Joseph C. Bernier, of Quebec, regarding his proposed polar expedition: "I have two plans to lay before the Canadian Government on my return, each of which are based upon my long personal acquaintance of Arctic seas and have been approved by the best Arctic authorities. My first plan is to start by way of Behring Straits, follow the coast of Siberia and enter the ice between 165 and 170 degrees of longitude East. I shall then push north as far as the ice will permit. When my ship gets into the ice I shall then place myself in the hands of nature. If she gets into a better position than the track of the *Jeannette* I shall expect to reach the Pole, and return in between three and four years. This will not be so difficult as in the case of the *Jeannette*, because the polar basin at the present time has more openings than in past years, this being due to the changed climatic conditions. My second plan, which has already been privately submitted to the Quebec Geographical Society, is to start from Franz Josef Land with a large number of dogs and reindeer and travel during the summer to the Pole by sleighs, taking with me concentrated provisions and killing my reindeer day by day for food. Elaborate calculations have been made as to the number of dogs and reindeer required for sleighing and for food. Traveling at an average of six miles per day the journey to the Pole should occupy 150 days, at the end of which time I should still have enough provisions to return towards Spitzbergen before winter set in. The point of

the whole thing is that I intend to reach the Pole—I say I ought to get there in 150 days, but I have allowed 180 for the purpose. If I leave Franz Josef Land when the sun rises this would still leave (allowing 180 days for the journey), ten days of remaining light for me to travel towards Spitzbergen. At the expiration of this time I should put myself in winter quarters on the ice, kill the remaining reindeer for food and all the dogs not required for the rest of the homeward journey in the spring.

UNIVERSITY AND EDUCATIONAL NEWS.

PRESIDENT FAUNCE has announced that Mr. John D. Rockefeller has offered to give $250,000 to Brown University if a million dollars is collected. It will be remembered that a million dollars has already been obtained for Brown University, of which Mr. Rockefeller gave $250,000.

MRS. ANNA C. HOUGH, of Los Angeles, has offered $25,000 to the University of Southern California in case an additional sum of $75,000 be collected.

THE proprietors of the Baldwin Locomotive Works have subscribed $25,000 towards a new engineering building for the University of Pennsylvania.

A BILL has just passed the Senate granting the North Dakota Agricultural College one-fifth mill on all taxable property, thus ensuring the continuous support of the Agricultural College in place of the uncertain biennial appropriation. Plans are being prepared for a new chemical laboratory and for a science hall to be built during the present year, also for a new barn to replace the one recently destroyed by fire; loss $18,000, insurance $12,000.

THE legislature of Wyoming has made an appropriation to complete the Science Hall of the University of Wyoming and to enlarge the campus. The new building will contain the geological museum and preparation rooms, the botanical and chemical laboratories and a large lecture room. A central heating plant for all the buildings will also be built.

BEGINNING with June of the present year the University of Michigan will confer but one degree, that of bachelor of arts, on graduates from the undergraduate courses. The degrees of bachelor of philosophy, bachelor of science and bachelor of letters, which have been conferred for more than twenty years, are to be dropped. This change is brought about by the following resolution, which was passed by the literary faculty on February 18th and by the Board of Regents on February 21st:

> Beginning in June of 1901, the degree of bachelor of arts shall be conferred on any student who has satisfied any one of the four sets of requirements for graduation now in force in the department of literature, science and the arts.

THE annual commemoration day exercises at Johns Hopkins University on February 22d, were unusually impressive, as they marked the quarter centennial of the founding of the university and the formal announcement of the resignation of President Daniel Coit Gilman. The address was made by the Hon. David Jayne Hill, Assistant Secretary of State and formerly president of the University of Rochester.

THE following memorial on the subject of Coopers Hill College has, as we learn from the London *Times*, been signed by some 374 leading men of science and others interested in education:

> The correspondence regarding Coopers Hill College which has been published in the *Times* of January 3, 1901, which includes Sir Horace Walpole's letter to Colonel Ottley of December 14, 1900, and Colonel Ottley's letter of December 17, 1900, has caused a painful shock to those engaged in higher education throughout the United Kingdom, and to all who are interested in the training of engineers.
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> This correspondence relates to the sudden and arbitrary dismissal of able and distinguished scientific teachers who have been doing duty in the college for periods of from nine to thirty years, and the value of whose past services is at the same time officially recognized.
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> Such arbitrary dismissal is likely to affect adversely the cause of scientific teaching in the United Kingdom. It cannot fail to injure the future of the college. During the correspondence which has ensued it has become apparent that the teaching staff have no voice in the educational policy of the college and are not consulted when any change in the curriculum

is contemplated. We wish to draw the attention of the Secretary of State to this unsatisfactory state of affairs, which must militate against the success of the college as an educational center.

The sudden dismissal is action of a kind which we were not prepared to expect in any institution under the control of the British Government, and we think that the seven members of the staff who are required to retire at three months' notice are justified in asking for the inquiry into the working of the college for which they have petitioned in their memorial of December 27, 1900.

We therefore desire to express our hope that the Secretary of State for India will see his way to grant their request, and to suspend proceedings until an adequate inquiry by competent persons shall have been held.

In support of this memorial a deputation waited on Lord George Hamilton, Secretary of State for India, and addresses were made by Lord Kelvin, Lord Lister, Lord Raleigh, Sir Henry Roscoe, Professor H. E. Armstrong and Dr. G. J. Stoney. Lord George Hamilton made a reply defending the action of Colonel Ottley and the Board of Visitors. He stated that the Board of Visitors recommended the action unanimously after careful examination and that it included Sir J. Wolfe-Barry, Sir William Preece and other competent scientific men. Pensions had been granted to members of the staff. Thus Professor McLeod, whose salary was £600, received a pension of £466 and a gratuity of £185. Sir George Hamilton deprecated the agitation through the newspapers and refused a further inquiry. The following letter from Lord Kelvin is published in the *Times* for February 13th.

Sir:—Lord George Hamilton's answer to the deputation regarding Coopers Hill, yesterday, was certainly far from satisfactory in respect to the dismissal of members of the scientific staff. It gave no reason to believe that any one of those threatened with dismissal had been found in any respect incompetent or negligent in the performance of duty. Evidence brought forward by myself showed that members of the Board of Visitors were astonished to hear of seven of the scientific teachers being threatened with dismissal by Sir Horace Walpole's letter of date December 14th, and believed that the recommendations referred to in the first paragraph of that letter did not imply the supersession of more than two of the teaching staff.

Nothing in Lord George Hamilton's statement was directed to show that the recommendations for amendment in the college teaching by the Board of Visitors could not have been carried out in a thoroughly satisfactory way by the president and his present teaching staff; with perhaps some moderate change in the allocation of their duties. I had suggested in my own statement of the objects of the deputation that the official prospectus issued on January 1, 1901, which promised to the public the present staff and the present allocation of subjects, should be allowed to hold good until the end of the present session. I have ventured respectfully to repeat the suggestion to-day to Lord George Hamilton, to whom I send a copy of the present letter.

Yours faithfully,

KELVIN.

15, EATON-PLACE, S. W., Feb. 13.

PRESIDENT MCKINLEY has appointed Capt. William Crosier, of the Ordinance Department, to succeed the late Col. Michie at West Point as professor of natural and experimental philosophy.

A CHAIR of irrigation has just been established in the University of California, and Professor Elwood Mead, of the United States Department of Agriculture, has been called to it. Professor Mead will not resign charge of the irrigation investigation of the United States, but will take his class into the field with him during the proper months, giving up two months to lectures at Berkeley.

ELMA CHANDLER, who has been an assistant in the botanical laboratory of the University of Michigan for the past four months, has accepted a position in the schools of Elgin, Ill.

MR. E. J. GARWOOD has been appointed to the Yates Goldsmid chair of geology and mineralogy at University College, London, in succession to Professor T. G. Bonney.

AT Christ's College, Cambridge University, Dr. Alfred Cort Haddon, formerly scholar of the college, university lecturer in ethnology and professor of zoology at the Royal College of Science, Dublin, has been elected to a junior fellowship.

THE Isaac Newton Studentship in physical astronomy, of Cambridge University, has been awarded to Mr. S. B. McLaren, of Trinity, third wrangler, 1900.